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**APPLIED METHODS
AND MEANS OF INVESTIGATION**

Gaston Ramon

O. GAN

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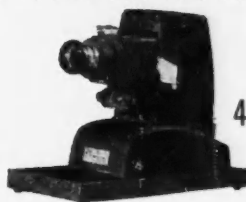
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Applied Methods and Means of Investigation¹

GASTON RAMON²

Dr. Gaston Ramon is internationally known for his epoch-making contribution to preventive medicine in the development and use of anatoxins (toxoids) against diphtheria, tetanus and other diseases. Marking his great accomplishments, his colleagues, friends and students arranged this year for the publication of a volume containing his research contributions during the forty years of his scientific career. To give the members of the Canadian Public Health Association an insight into this memorable volume, Dr. Ramon has permitted the Journal to publish extracts. The chapter which introduces the methods employed in the development of toxoids has been selected and a portion published. It is felt that Canadian public health workers will be reminded of the monumental work of Dr. Ramon and the significance of his great achievements.

IN this article I would like to describe the foundation of my research and the methods I have followed in my investigations. Since there is, at present, much discussion about scientific research taking place in France and elsewhere, I thought that consideration of the methods and means of investigation which I have employed might be of some interest.

Fact derived from observation has been the very foundation of my investigations. While examining facts I would make assumptions that I tried to verify by experiment. For example, I decided in 1921 to investigate the dissociation of the toxin-antitoxin complex which appears in mixtures of filtered diphtheria broth and antidiphtheria serum. In some of the mixtures which had been left aside for experimental purposes either in the incubator (37° C.) or at room temperature, I observed a very light opalescence which was followed by a

¹This article is one of the thirty chapters of Dr. Ramon's book *Quarante Années de Recherches et de Travaux* published in May, 1957.

²Directeur de l'Office international des Epizooties, 12, Rue de Prony, Paris 17, France. Directeur honoraire de l'Institut Pasteur.

progressively increased intensity. I first assumed that this opalescence was due to a microbial contamination and growth in the favourable medium which consisted of the mixtures of filtered diphtheria broth and serum. In order to avoid what I thought to be a microbial culture I added to the mixtures a small quantity of formalin which, on my recommendation, had been used in France since 1915 for ensuring bacteriological sterility of sera used in therapy. I observed that in spite of the addition of this antiseptic the same opalescence could be observed in some of the mixtures and that this was followed in one of the mixtures by the appearance of a slight precipitate which agglomerated into "flocules". This was the phenomenon of "flocculation". This was the "initial flocculation" which is the characteristic feature of the phenomenon. The experiments which followed, both *in vitro* and *in vivo* from these observations, proved in fact that in the mixture showing initial flocculation there was a mutual neutralization of the two specific components of the mixture, namely the toxin and the antitoxin. Thus, I was led to the establishment, on the one hand, of the method for the quantitative measurement of the antitoxin and, on the other hand, of the method for the estimation of the intrinsic antigenic value of the toxin (1922) (1). Pursuing my research, I demonstrated the possibility of dissociating the toxin-antitoxin complex which is present in the flocculate and of recovering either component, this having been the object of my very first research. Subsequently, I applied the flocculation reaction to the quantitative measurement of various antibodies and antigens.

The flocculation phenomenon and reaction led me rapidly to the demonstration of diphtheria anatoxin (toxoid) utilizing the same method. I had noticed that a very small amount of formalin added to the diphtheria toxin did not in the least disturb the phenomenon of flocculation. By contrast, formalin, as well as many physical and chemical agents, has the property of altering the toxicity of diphtheria toxin. As I continued my experimental investigations, I showed that diphtheria toxin which has been subjected to certain influences, can partially—and even completely—lose its harmfulness for test animals while retaining its flocculating property towards a specific antitoxin (June 1923) (2). I then asked the following question: "Is a toxin which has been completely deprived of its toxicity but has kept its flocculating property unaltered still a good immunizing agent and, if so, to what extent?" This question I answered affirmatively in December 1923 (3) when I stated: "A toxin, which under the action of both formalin and heat has lost its harmfulness completely but which, by contrast, has kept unaltered its capacity of flocculating when it is mixed together with antidiphtheria serum, is apt to cause, in test animals, the appearance and the development of an immunity against the diphtheria toxoinfection."

To this toxin which had thus been transformed into a new substance presenting essential specific properties, viz., complete harmlessness, flocculating potency, and immunogenic activity, was given the name "anatoxin". I immediately proposed this anatoxin for the immunization of children against diphtheria. It was in this manner that diphtheria anatoxin and the principle of anatoxins and anatoxic vaccinations were demonstrated.

A great number of observations which were controlled by experiments enabled me to establish the principle of adjuvant and immunity-stimulating

substances (1925) (4). At that time I was in charge of the immunization of horses producing antidiphtheria serum and the titration of the serum by means of the flocculation reaction which I had just established. I noticed on several occasions that the antitoxic potency of sera of some horses suddenly increased and that at the site of inoculation of the antigen (either diphtheria toxin or anatoxin) these horses were showing severe inflammatory reactions and sometimes even, abscesses. As I assumed a relation between the cause and the effect, I undertook a series of experiments on horses with a view to trying to reproduce these reactions and thereby the increase in the antitoxin titre. I used many substances including gelatin, agar, oil, lecithin, and tapioca. My choice fell on the last, the addition of which to the antigen before its inoculation into the horse produced the looked-for increase in the production of antitoxin. In man, after various trials, it came to my mind to employ the anti-typhoid-paratyphoid vaccine (T.A.B.) as an adjuvant which would stimulate the immunity conferred by the anatoxins; this was the origin of the method of "combined vaccines".

* * * *

Another example of my methods of investigation is provided by the study which I made on naturally acquired immunity. I first gathered a great number of observations of man and of animals concerning this sort of immunity in its specific forms (anti-diphtheria, anti-tetanus, anti-staphylococcal, etc.) as well as the immunity directed against viruses such as cowpox virus and poliomyelitis viruses or against some microbial ferments such as tetanus gelatinase, etc. After I had shown that certain theories were untenable, I pursued extensive experiments which enabled me to demonstrate the "mechanism" of naturally acquired immunity, to establish the role of the infective agent, etc.

* * * *

These various examples give an illustration of my method of work which was based on observation and experiment* and which, within a few years, (1922 to 1925) had led me to my main discoveries, viz.:

- the phenomenon and the reaction of flocculation, the latter founded on the appearance of an early flocculation;
- diphtheria anatoxin and the principle of anatoxins and anatoxic vaccinations;
- the principle of adjuvant and immunity-stimulating substances and of combined vaccines.

*These initial experiments and the greater part of further investigations had been carried out by myself alone in the isolation of a "laboratory" where I had at my disposal only the most inadequate material and facilities which consisted of syringes, test tubes, an autoclave, a water-bath and a "photographic" lantern which had been devised for examining the flocculation reaction and which greatly facilitated my work in this connection.

In my personal laboratory I never had with me any laboratory technicians or assistants. I always preferred to do myself as many things as possible and this has enabled me to discover facts such as the phenomenon of flocculation and the initial flocculation; the establishment of the persistence of the flocculating potency of a toxin which has had its toxicity attenuated or even destroyed; the relation between the increase in the antitoxic titre of antidiphtheria sera and inflammatory reactions in the experimental animals, etc., which would have escaped my notice had I entrusted other people with the manipulations.

These were really discoveries in the sense considered by Claude Bernard: "The discovery is the idea which is linked with a new fact. It is the new idea which arises in connection with a fact which has been found by accident or in any other way."

The examples and detailed information which I have just given concerning the circumstances and conditions in which the flocculation phenomenon, anatoxin and the principle of adjuvant and immunity-stimulating substances, etc., were demonstrated, show that, in fact, discoveries are not "looked for" but that they offer themselves somehow spontaneously to the observer who must seize them and not let them slip.

However—and Pasteur has often said so prior to me—discoveries in biology are rarely the achievement of one individual only. The discovery of diphtheria anatoxin in 1923, just as the discovery of antitoxin by Behring and Kitasato in 1890, had benefited from Roux and Yersin's authoritative work on diphtheria and diphtheria poisoning (1888). It is for this reason, among others, that I have dedicated this book to the memory of Emile Roux.

Pasteur's discoveries concerning the virus vaccines had also largely benefited from the works carried out by Jenner and some earlier scientists such as the veterinarians Toussaint, Galtier, and others.

* * * *

I want to stress once more the progressive development which has marked my fundamental researches and the links which have connected my studies with each other. One will no doubt notice repetitions from one chapter to another but how could it be otherwise in view of the inter-dependence of my investigations?

* * * *

Before putting forward the various anatoxins (against diphtheria, tetanus and staphylococcal infections, etc.) for the immunization of man and domestic animals against some diseases, I had established in minutest detail the techniques for their preparation, for the very strict control of their harmlessness and for the estimation of their intrinsic antigenic value and immunogenic potency by means of the reaction of flocculation.*

Because of the great number of experiments which had previously been carried out in animals, I was able to set up the immunization methods to be applied in human medicine, i.e. number and volume of the anatoxin injections or of the "combined vaccines", route of inoculation, interval between injections, administration of a booster dose, etc. Since their establishment, these methods have not been subjected to any important changes.

*For twenty years I had personally been entrusted, in field practice, with the preparation and the evaluation by means of the flocculation reaction of the antigenic and immunogenic potencies of tens of thousands litres of the various anatoxins designed for current use in France. Besides, I assumed the control for the harmlessness of anatoxins in experimental animals and this I had been carrying out for about ten years until the day when illness (an acquired allergy to guinea-pigs) compelled me to leave this control to my co-workers of that period.

I had also envisaged problems which could arise in the course of the application of anatoxic immunization and I tried to find, in advance, a solution to them. It was thus that from my earliest studies (1924-1926) on tetanus immunization I considered the case of wounded subjects who were not yet actively immunized. For such cases I had investigated, established and recommended serum-anatoxin vaccination consisting of the simultaneous inoculation of tetanus serum and tetanus anatoxin to be followed by two injections of the latter.

At the very beginning of my investigations, I also defined the experimental techniques which enabled me to search for, and measure, diphtheria, tetanus and staphylococcal antitoxins in sera of vaccinated subjects in order to be able in this way to find out the appearance, development and duration of immunity conferred by anatoxins.

• • • •

I have always considered that the immunologist must constantly aim at the improvement of the methods which he has created and the practical application for which he is directly responsible. He must concern himself with the perfecting of the methods in order to increase their efficacy. This is what I have done when, for example, I tried to augment the intrinsic antigenic value, and consequently, the immunogenic potency, of the anatoxins. In doing so I followed the directions which Claude Bernard had formerly given when he stated: "New ideas and discoveries are like seeds; they also need be nourished and developed by scientific knowledge; without it they die or else they emigrate elsewhere and then they are seen to thrive and bear fruit in some fertile ground which they have found far away from the country which saw them originate."

• • • •

In the application of the various methods of anatoxic immunization everything was done methodically with the utmost care and after taking all the necessary precautions, as much in the preparation and control of the anatoxins at the laboratory as in their utilization in field practice. Trials of immunization against diphtheria were first carried out in France as early as the end of 1923 by the most qualified clinicians and health workers on private persons (children and adults) then gradually in larger communities. These very numerous trials which were conducted for a period of ten years gave unquestionable evidence that diphtheria anatoxin, while it is harmless, is at the same time capable of conferring on children as well as adults solid and durable levels of immunity against Bretonneau's disease. It was then, and only then, that diphtheria immunization entered current practice. It was made obligatory in the French army in 1936 and in the civilian population in 1938 (children aged between 1 and 14 years). Similar development took place with immunization by means of tetanus anatoxin and with combined immunization, etc.

• • • •

These are the methods and means which have been put into practice and these are the principles which led me in my fundamental research that proved later to be particularly fertile in its direct and indirect consequences.

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EXTENSION OF MEDICAL CARE SERVICES IN NEWFOUNDLAND

Recently, Premier J. R. Smallwood announced an extension of the services to be offered to the provincial government's Children's Health Plan. The first stage of this plan became effective on January 1, 1957 with the provision of free hospitalization, including laboratory and X-ray diagnostic services as well as out-patient diagnostic services performed in hospitals for all those under the age of 16. Steps have now been taken to implement the second stage of this four-stage plan. Physicians' and surgeons' services to hospital in-patients have been made available to children without charge. At the present time, the majority of children in the province are already included in the Cottage Hospital Plan which furnishes complete medical care to more than half of the population throughout most of the province.

The hospital plan excludes St. John's and certain other areas. As a result of this new provision a reduction in the annual family premium will become effective March 31 and the annual Cottage Hospital fees will be reduced from \$15.00 to \$10.00 per family.

It is intended to put the plan into operation in several steps which will later include the provision of home medical care and all other types of health service. Physicians' and surgeons' services to hospital in-patients will be paid from the public treasury. About 179,000 children will be covered in this plan at an estimated annual expense of \$1,500,000. The burden of these additional public expenditures will be met by increased federal grants and ultimately the national hospital scheme will share the hospital costs.

What Effect will Changing Function and Conditions have on Hospital Planning?¹

HARVEY AGNEW,² M.D., LL.D., F.A.C.P., F.A.C.H.A.

In our field of interest the tempo of change seems to be steadily rising. We hear much about the changing functions of hospitals. To many of you, who may have tried vainly for years to have your hospital adopt some highly desirable new project, progress and change may seem painfully slow. But if we look back a decade, or two decades, the changes are both numerous and obvious, and a generation is but a short period of time in the progress of society's welfare and ecologic development.

Much has already happened to alter the functions of our hospitals; as a result, plans which were new yesterday are obsolete today. The biggest problem in planning is not merely to be up-to-date, but so to read the crystal ball that what we plan today and open two to three years hence, will still be up-to-date ten years later. What we build now should still be functionable, not only after a decade, but for sixty to seventy-five or more years from now.

Sometimes we see fairly clearly what would be an ideal solution for a certain situation—possibly in methodology, in planning, or in medical economics—but sometimes long-established tradition or universally accepted approaches make it difficult to achieve optimum results. You may remember the story about the old farmer who was asked by a confused motorist how to get to Jackson's Corners. "Well," said he, after some cogitation, "if I wanted to get there right easy, I wouldn't start from here!" But we must start from "here" and it is to the credit of many leaders in the hospital and related fields that we have gone as far as we have, and generally, in the right direction.

What are some of the influences looming up that will affect our planning?

Effect of Hospital Insurance on Function

Of most immediate concern is, "What changes can be expected as a result of the government-sponsored hospital insurance program?" This hospital insurance program is not in itself a changing function, of course, but such could result from it. We know from experience in Western Canada that an increased demand for accommodation can be expected. A factor in this demand may be a general desire that hospitals broaden the scope of their work, as well as accommodate more people and for longer periods. Naturally, various ways of keeping the usage of hospital beds to the level of necessity, rather than of demand, will be considered and probably tried.

Diagnostic Facilities

One means will probably be to keep to a minimum the use of beds for patients undergoing diagnostic study—laboratory or radiological study. Many beds are now occupied by patients undergoing such studies and undoubtedly

¹Presented at the convention of the Ontario Hospital Association, October 29, 1957.

²Dr. Agnew is a partner in the hospital consulting firm of Agnew, Peckham and Associates, Toronto. He is also Professor of Hospital Administration at the University of Toronto.

the use of diagnostic procedures will increase. Two effects on planning are foreseen: 1. If hospitals are not to be crowded with patients admitted primarily for diagnosis, there will likely be regulations requiring that these studies be largely undertaken before admission. In other words, such patients, if not bedridden, would come to the hospital as outpatients on appointment and go directly to the department concerned. In the case of larger hospitals with considerable referred work, one foresees patients from a distance staying at an adjacent hostel, possibly operated by the hospital, and reporting at appointed hours for examination. Alternately, a hospital could have a lightly staffed floor where such patients could be accommodated.

As corollary to that procedure, a higher percentage of the admitted patients would be for operation or would be seriously ill and, therefore, the ratio of nursing staff and of operating rooms and other clinical facilities to beds, would need to be increased.

2. The other effect of the greater use of diagnostic facilities would be a continuing expansion of the laboratories and the radiological departments. Many students of medical economics believe that one of the next steps in making modern medicine more readily available to the people will be to make diagnostic procedures more accessible and less costly. Existing formulae of square-footage required for these departments are now proving quite inadequate and any such departments being planned today should be designed so that ready and extensive expansion could be made.

It is easy to envisage the development of entire units designed solely for diagnostic purposes. These units would be maintained primarily for short-stay patients who did not require total bed care; they would be planned to provide an up-patient lounge room, dining room and a patio or open sun deck, if possible. Such a unit would be heavily staffed by technical personnel but would require no intensive nursing care. There would be a strong concentration of X-ray and laboratory services of the diagnostic type, electrocardiography, basal metabolism and electro-encephalography, where feasible, plus a good supply of examining rooms. This concept of units developed for diagnostic study makes the hospital's function of the prevention of illness more realistic and valuable; it will require careful liaison and agreement with the professional diagnosticians, but it is a logical step for the public, the hospital and the doctors for which we should make provision in our planning today.

The extent to which this factor of bed demand for diagnostic study can be controlled will have considerable bearing on the beds required per 1,000 of population. A possible effect on our bed provisions may be an increased popularity of the four-bed standard accommodation, as the old larger wards disappear. There is some evidence that the insurance plans may lead to heavier demands for four-bed rooms and single rooms with a decreased demand for the now popular two-bed room.

Home Care

Another factor will be the number of beds which can be released by some program of home care for patients in the subacute and convalescent stages. Undoubtedly, these programs in many larger cities on the continent have proven their value to patients, to hospitals and to the community as a whole. Most of these plans have been for general ward patients with the hospital

supplying the physician. In order to achieve widespread adoption in the average community here, applicability of the plan to a program including the family physician, a visiting nurse (possibly a Victorian Order Nurse) and the equipment and facilities of the hospital will need to be well demonstrated. This should definitely be possible and the development of our hospital insurance program could well hasten that day. This would mean relatively fewer beds (although the number might still be high), also the development of administrative facilities in the hospital to direct the program, extra equipment to be loaned for home use, and possibly, transportation facilities.

The Chronically Ill

Owing to the lack of proper facilities in most of our communities for the care of the long stay patient, a surprisingly large number of patients are being kept indefinitely in our active treatment general hospitals. We hear of patients being in a general hospital bed for four or five, or even more, years.

Some long stay patients, of course, do need the facilities of the general hospital, but we know that a large percentage of these patients could be quite adequately cared for in a less costly environment, and the occupancy of a general hospital bed for one year by such a patient means that its use has been denied to some forty acutely ill patients who needed those particular facilities.

Several factors may have a bearing on our planning: 1. There is an increasing realization that the chronically ill need good care and cannot be discharged from a general hospital without some provision being made for them. The problem has been to separate long stay patients into categories—those requiring the facilities of the general hospital, those requiring less intensive medical and nursing care or laboratory check-up, and those requiring mainly custodial care. 2. The provision of infirmaries for the bedridden in many of our county welfare institutions with the generous assistance of the Department of Welfare should prove helpful in caring for those patients not needing general hospital facilities. 3. The elimination of a time limit in providing hospitalization under the new program will make it necessary to develop a clear cut policy with respect to the long stay patient. If this is not done, the turnover of patients in our general hospitals will slow down and the shortage of beds will become still more acute. 4. Home care, already referred to, must be mentioned again, as a factor in the care of the chronically ill, as well as for shortening the stay of the acutely ill patient.

For those longer stay patients who should remain in the general hospital, we anticipate that it would be more economical in operation and would make fewer inroads on the already inadequate nursing staff to have them in a separate wing or building. Such a unit should be designed for long stay patients and have adequate solarium, corridor railings, readily accessible toilets, good reading lights, easily lowered beds, ready access to terraces or open balconies, level floors or easy ramps, TV, library facilities, some occupational therapy, and possibly some dining area facilities.

Medical Offices in Hospitals

For some time a small number of hospitals have provided facilities which may be rented to members of the medical staff for office space. (I am not

referring here to large teaching hospitals with salaried heads of clinical teaching services whose offices are usually in the hospital.) More and more we hear requests from doctors to provide this accommodation; the advantages to them in the saving of travel time, use of the existing plant, diagnostic, secretarial and many other services are obvious. The benefits to the hospital are also very real in having the medical staff so readily available for emergencies, for advice and for meetings; in addition this makes better use of the diagnostic and pharmacy services of the hospital, and they may be built and operated at no financial loss to the hospital. This concept has developed slowly in some areas, but is very active in others where it has worked exceedingly well and to the satisfaction of the doctor and hospital; it is certainly worth consideration in long-range planning if the medical staff exhibit a definite interest and are prepared to take space.

Other Effects on Planning

The changing nature of society and the evolving pattern of social practices will produce other influences on our hospitals. Increased industrialization, linked with a population which has forsaken human legs for balloon tires, will mean increased emergency work. Already we see a trend to rush injured persons to a hospital rather than to a doctor's office and this trend will increase. Increased longevity will probably mean more urology among older men. Cancer will probably be increased unless a specific cure is developed, however, apart from diagnostic procedures and surgical intervention, more of the specialized cancer treatment may be centered in strategically located centers.

The outpatient department in the city hospital may also be subject to considerable alteration in scope of function in the near future. Already, the provision of medical welfare plans for the indigent and for various welfare aided groups, has had an effect on transferring a number of these former patrons to private doctors' offices and it is reasonable to assume that the provision of hospital insurance and more diagnostic centers will reduce further the demand for the services of the established outpatient department.

With shorter hospital stay, medical teaching is shifting to a considerable extent to the outdoor clinic. This, naturally, will affect the layout, with larger examination rooms, conference rooms, students' rooms and other requirements.

The development of TV has opened up a new possibility in the teaching of surgical technique, never satisfactory for groups herded into side-wall observation galleries or trying to peer over shoulders from the floor. While the equipment is still expensive, it is not much more so than the cost of a gallery and is much more effective.

The greater interest of the general hospital in the mental health of patients is shown by the increasing number of psychiatric services which have been developed. These wings require special planning, with a high proportion of space for up-patients. In addition to the usual psychiatric clinic for out-patients, a number of hospitals have set up a "day-hospital" which provides supervision of the non-admitted patient from 9 a.m. until 4 p.m. and some now have evening groups as well from five o'clock on.

The greater use of hospitals for diagnostic procedures, the greater incidence of emergency work, and the likely increase in the number of medical offices in hospitals will tend to make an accessible location quite desirable. With the

shorter average stay of today, a location in the "great open spaces" of the outskirts is not so strongly advocated as a generation ago. In many of our rapidly growing communities, what seems to be far out in the country today often becomes practically down-town by tomorrow. We are building permanent, fire resistant structures not for a decade but for 60 or 70 years, probably longer, and, taking the long range viewpoint and the desirability of having sufficient acreage for parking and for future expansion, a location in the direction of future growth may be the wise decision.

Effects of Personnel Shortage

Of much concern in planning are the varied effects of the shortage of nursing and other personnel, skilled and unskilled. Some of these effects are evident now; others are certain to develop. Increased automation will undoubtedly occur. The use of labour-saving equipment is increasing; much of this should be planned for in building, for later alterations are expensive. For instance, the new compact automatic X-ray film developers and driers take only a few square feet and valuable space thus saved can be used for other purposes. The newer dish-washing equipment with its marked advantages should have space planned for it. The food service selected will affect the size and planning of kitchens and floor serveries. Horizontal and vertical conveyors are becoming very common. So far we have not heard of patients or staff being put upon horizontal or basket conveyors, but with the new moving platforms for subways, that may not be too fantastic.

With the greater and more concentrated use of lower floors for the diagnostic services, physical medicine, outpatients, administrative functions, cafeteria, lounges, et cetera, there is a tremendous concentration of activity and of vertical movement between two or perhaps three floors. A costly time loss, not always realized, is that of waiting for elevators. Much of this could be prevented by the use of escalators between these lower floors. True, escalators do take more square-footage, which has deterred a number of hospitals from installing them. We believe, however, that they will be used more in the future as time-loss becomes more costly. An up-escalator only, as in the subways, would not be very costly and should prove quite helpful.

Early ambulation and earlier discharge have already had noticeable effect on hospital planning. Also, the shortage of nursing and related personnel will probably necessitate more self-help. This has been most apparent in some of the Permanente and other hospitals on the West Coast, where running hot and cold water are right beside the bed and the patient has push-button controls for the bed-curtains.

Intensive Care Unit

Finally, a development which will not only add to the patients' chances of recovery but should conserve nursing staff is the intensive care unit where post-operative and seriously ill medical patients can be kept until the acute stage is over. Here, the best nursing staff and all necessary equipment can be concentrated. The saving in operational cost comes from being able to reduce the nursing staff elsewhere. A specially designed ward is desirable. There are a number of practical problems associated with this procedure, but they are not major ones. It is most effective in hospitals over 150 beds in size.

Antibiotics in Foods: A Review of Some Public Health Aspects

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THE public health aspects of the presence of antibiotics in foods have aroused extensive controversy. The topic is a specialized facet of the present trend of technological development in food production through the use of chemicals.

The control of chemicals in foods is already a burdensome national problem and is becoming of international importance through the direct interest of W.H.O. and F.A.O. Chemicals are promoted for commercial use in foods as anti-oxidants, stabilizers, emulsifiers, bleaching agents, preservatives, non-sugar sweeteners, colours, flavours, tenderizers, growth promoters and in many other categories. In addition, chemicals may gain entrance into foods as members of a diverse and ever-expanding array of highly toxic fungicides, insecticides, herbicides, fumigants, disinfectants, or through the feeding of estrogenic compounds to beef cattle. Most of these substances, however, do not normally have other important uses that would cause them to be ingested by man or otherwise contact his person. Antibiotics are different. Their highly specialized function in the treatment of serious bacterial infections makes it imperative that they should be assigned no unessential secondary role which would reduce their effectiveness in the treatment of disease (15).

POTENTIAL METHODS OF ENTRY OF ANTIBIOTICS INTO FOODS

Antibiotics may find their way into foods through several potential channels: as growth promoting adjuncts in feeds for cattle, swine, poultry—now an almost universal process; as residues from sprays or other treatments applied to crops in the control of bacterial pathogens of plants; through their therapeutic use in cattle and particularly by the contamination of milk as a result of intramammary infusion; and the more recent direct application to specific foods as preservatives.

Widespread agreement seems to exist that the use of antibiotics in the feed of meat animals has not led to untoward effects in man, and is generally accepted as an economically sound practice. An early fear that this practice would lead to the emergence of a numerically dominant population of resistant pathogens has not been fulfilled in experience (8) though isolated occurrences have been reported. Residues of bacteriologically active antibiotics are not encountered in the flesh of animals that have received commercially recommended levels of antibiotics (up to 20 ppm) in feeds throughout their life-span, nor are the antibiotics used in veterinary treatments recoverable from animal tissues a few days after treatment (35).

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In Canada, the use of antibiotics for the control of crop diseases is limited in scope. When applied in the treatment of seed no residues are found in the crop at harvest and such practice is, therefore, of no concern in this discussion. The same is true in the experimental use of streptomycin and other antibiotics in the control of bacterial plant-pathogens such as those causing "softrot" and other infections of leafy vegetables or the "fireblight" disease of apples, provided that treatments are not made near to harvest time. The suggestion of Goodman and Johnston (9) seems a wise one, namely, to limit the use of antibiotics on vegetables or fruit in accord with a treatment schedule so timed that no residues are detectable at harvest. This attitude might well apply to the application of actidione and derivatives in the control of stem-rust of wheat, and of specific fungal infections of fruit-trees, and to the pre-storage treatment of "root" crops with various antibiotics. These problems are currently under investigation. These and the use of antibiotics in canned foods remain experimental projects and are not yet a commercial public issue. Processing destroys any tetracyclines when added to salmon prior to canning (26).

Antibiotics, particularly streptomycin, and sulphonamides have been used to some extent to control the "foul brood" disease of honey-bees caused by *Bacillus larvae*. The significance of the residues found in honey does not yet appear to have been appraised.

Nisin, an antibiotic produced by certain strains of the cheese starter-culture organism, is being used in the United Kingdom for controlling specific types of spoilage of cheese caused by clostridia and has been recommended to combat a number of other food spoilage problems (10). This antibiotic is not used therapeutically nor is it in commercial use in Canada. In the United States, polymyxin has been used during the fermentation of beer to control a common Gram negative contaminant of yeast. It is not normally found in the finished product.

The main issues to consider in the present discussion seem to be the use of antibiotics as preservatives in flesh foods, and the presence of antibiotics in milk as a sequel to their use in the control of bovine mastitis. These will be treated separately.

ANTIBIOTICS AS FOOD PRESERVATIVES

Many appealing claims have been made regarding the efficiency of specific antibiotics in delaying the onset of bacterial spoilage and in prolonging the period during which certain perishable foods can retain the characteristics of "freshness" and can safely be marketed as such. As a result, secondary advantages have been pointed out: reduced loss from spoilage, the expansion of marketing ranges, the feasibility of improved packaging, food conservation in a hungry world, the contribution to an improved diet in technologically undeveloped countries, the simplicity of the treatment and its introduction with a minimum capital outlay.

In the treatment of fish or poultry, the usual procedure has been to pack the product in ice into which the antibiotic has previously been incorporated or to immerse the product in a chilled agitated solution of the antibiotic at some critical period in the processing scheme. Intra-arterial or intra-peritoneal in-

fusions prior to slaughter have been experimentally applied to the larger meat animals.

In Canada, commercial interest in this field has been largely limited to chlortetracycline and oxytetracycline, and primarily for the control of bacterial spoilage in fish and poultry, but the diversity of experimental study currently in progress suggests that proposals may be made in due course for the use of antibiotics over a much broader range of application and particularly with reference to their use in "red meats"—perhaps in conjunction with other antimicrobial chemicals or eventually as an adjunct to preservation by high energy irradiation. Accordingly, the request to allow the presence of antibiotics in fish and poultry within the scope of the Food and Drugs Act received the exacting challenge properly due to the far-reaching precedent that might be assumed if the practice were approved by law.

The Food and Drugs Act imposes the need to find satisfactory answers to two basic questions: *Would the introduction of chlortetracycline or oxytetracycline create any hazard to health? Would their introduction into foods offered for sale perpetrate a fraud?*

Potentiality for Fraud

With regard to the latter question, it was reasonably established that the proposed substances fulfilled, to the advantage of the consumer over currently accepted practices, the claims made for them in prolonging the shelf-life of fish and poultry provided that the antibiotics were not applied to foods already heavily contaminated or "stale", and provided that marketing practices did not attempt to over-extend the "extra" days of "shelf-life" (3, 14, 27, 39). These latter aspects did not seem insurmountable with reasonable co-operation from the food industries concerned and could be subject to control by inspection, analysis and appropriate labelling.

Potentiality for creating health hazards

In addition to proof of their effectiveness, any justification for use of antibiotics as preservatives in human foods should be required to meet the challenge of careful examination of the evidence in relation to such factors as the development of antibiotic-resistant pathogens or spoilage micro-organisms, the toxicity of the antibiotics or of their decomposition products or those derived from reaction with food ingredients, their carcinogenicity, propensity to induce allergy, the effect of a disturbed microbial ecology on food quality and spoilage, modification of food-poisoning probabilities and any "rationale" for expecting the mode of action of antibiotics in microbial cells to have parallel implication in human cells.

In order to appraise these health risks, a diversity of factors stemming from the specific properties of antibiotics must be evaluated. Contributory properties will be discussed briefly below. Space limitations preclude a complete review of the extensive and pertinent literature.

THE EFFECT OF ANTIBIOTICS IN RELATION TO PRESERVATION OF FOODS

The antibiotics recommended for use in foods exert a preservative action through exercising a bacteriostatic function. They are inhibitory to growth, not lethal. Thus the multiplication even of susceptible species is inhibited only

for such time as the concentration of the antibiotic is beyond the threshold level. The duration of its preservative action will thus be a function of the rate of inactivation. It may be inferred, therefore, that the effectiveness of a given antibiotic will depend in part upon the nature of the food. The comparatively high pH said to be encountered in shrimps as distinct from fish may lead to more rapid inactivation of the tetracyclines and hence explain inferior preservative action in the shell fish, while the relative availability of metallic cations in different foods may also influence the preservative action of tetracyclines (12).

If substantial growth of micro-organisms has occurred in a food before application of an antibiotic, it should be recalled that extracellular enzymes—the main agents of spoilage—are still free to function. Further, no antibiotic has yet been found which is effectively inhibitory to all genera of micro-organisms. Hence, in a heavily contaminated food that would be expected to harbour a taxonomic diversity of micro-organisms, a residuum of non-susceptible organisms is most likely to be encountered. Not only will these be free to multiply (within the limits of the environment) but the possibility must be entertained that lacking the competitive action of the inhibited component of the normal flora, they may be free to grow more rapidly and cause spoilage perhaps of a nature not normally encountered. Moreover, if the non-inhibited component should include a specifically resistant pathogen or one of food-poisoning propensity, the implication of unrestricted growth is obvious.

These several aspects point to three important considerations: (1) only a "broad-spectrum" antibiotic is likely to be effective as a general preservative in foods because of the inevitably diverse nature of the contaminants; (2) such antibiotics must be relatively stable under the conditions found in foods; (3) Antibiotics are unlikely to have commercial value as preservatives unless (a) they are applied to foods which have been produced and processed under standards of sanitation that keep the initial inoculum to a minimum, and (b) subsequent to treatment with antibiotics the foods must be held in an environment not conducive to multiplication of pathogens or to elaboration of enterotoxins, i.e., perishable foods must be kept under continuously effective refrigeration. The validity of these indications has been established in experience. The need on the part of the processor to obtain economic returns from the use of antibiotics in foods may well exert stimulation towards improved sanitation, rather than being persuasive towards the use of antibiotics as a substitute for hygienic practice—an eventuality originally feared. It is known that substantial sanitary improvements have been introduced on the part of many factories in response to such a spur.

The tetracyclines have gained preference as preservatives because they are bacteriostatic at low concentrations against a wide range of both Gram-positive and Gram-negative bacteria and are relatively stable in most foods. The antibacterial "spectrum" of an antibiotic is a highly specific property. Penicillin is quite unsuitable because of its limitation of effectiveness mainly against Gram-positive bacteria. Streptomycin has similar limitations though it is the more effective against Gram-negative species. For specialized purposes, however, an antibiotic of comparatively limited "spectrum" has found some favour, as for instance in the control of *Flavobacterium proteus* in brewers-yeast by polymyxin (of rigid antibacterial limitation); or the use of nisin in cheese to

control gassy spoilage caused by clostridia. The control of yeasts and fungi in foods has not yet been fulfilled by use of antibiotics. The antibacterial selectivity may, as has been shown under commercial conditions, on occasion lead to an abnormal predominance of yeasts in foods treated with antibiotics. Experiments have been reported involving the combined use of sorbic acid—effective against many yeasts—or antimycotic antibiotics and chlortetracycline.

THE MODE OF ACTION OF ANTIBIOTICS

Specificity of reaction is considered here only to point out that since each antibiotic probably functions uniquely, it is rational to require that assessment of the desirability of an antibiotic for use in foods should be independently based upon its specific properties, including, of course, those properties which could affect the degree and kind of hazard to the health of the consumer.

The basis of specificity of antibacterial action by antibiotics is not fully understood. The conclusion of Umbreit (31) that the function of each antibiotic is dependent upon its total molecular structure rather than upon the presence or orientation of specific structural groups within the molecule may offer a teleological explanation. It is known, however, that different antibiotics inhibit diverse physiological reactions. Which is the fundamental one for any particular antibiotic remains open to question.

The following will suffice to illustrate this functional specificity. The tetracyclines have been shown to interfere with oxidative phosphorylation in energy metabolism and to inhibit respiration, fatty acid oxidation, arginine catabolism, nitro-reduction, and adaptive enzyme formation (31). It has been suggested that enzyme inhibition by these antibiotics may possibly result from their capacity to function as chelating agents by virtue of which they may remove essential cations from the environment of enzymes requiring metallic prosthetic groups or may react with essential cations already attached to an enzyme molecule, thereby "blocking" that enzyme (33).

The affinity of chlortetracycline for specific cations may explain why this substance is so markedly effective in raw meats against many Gram-negative spoilage bacteria at very low concentrations (12) whereas the same concentrations would be ineffectual against the same species in culture broth. A more ready availability in the latter medium of cations essential to the bacteria is postulated as an explanation. Some unrelated studies recently completed in this laboratory tend to lend some support to this point of view. Oxytetracycline and tetracycline strongly inhibited the *in vitro* activity of two staphylococcal hemolysins. This inhibition was overcome by addition of Co, Mg or Mn ions, such cations previously having been shown to be essential for the functioning of the purified hemolysins.

The primary action of penicillin has been considered to be the inhibition of an early stage of ribose-nucleate synthesis (31), though its anti-bacterial action has been shown also to be associated with the inhibition of several enzymes and the disruption of the bacterial cell wall. More recently Prestidge and Pardee (18) concluded that penicillin induces the formation of a specific protein, probably an enzyme, that attacks the plasma membrane of the susceptible cell with a resultant increase in permeability which leads to leaching out of ribose-nucleate.

The essential antibacterial function of streptomycin has been suggested to

be the inhibition of an intermediary reaction between pyruvate and oxalacetate (a "key" reaction in the energy metabolism of many species) (31). This may be not incompatible with the more recent evidence that streptomycin reacts with bacterial nucleic acids which in turn delays the synthesis of specific induced enzymes (17).

Such mechanisms have further pertinence to the problem at hand. Many of the reactions inhibited in bacteria are known to occur in mammalian cells. To what extent may these inhibitions be activated in human cells if a subject be exposed to antibiotics as an ingredient in his daily diet?

No complete answer to this question is forthcoming. It becomes resolved to the "wordy" argument of specific cellular differences in susceptibility, though an indirect deduction may be made from toxicity data, to be discussed later, suggesting no significant interference by tetracyclines with the metabolism of human cells. An example of attempts to explain the specific difference in susceptibility to antibiotics of microbial and mammalian cells is available by reference to such studies with streptomycin. Evidence has been presented (32) to suggest existence of a selective permeability difference between susceptible bacterial cells and mammalian cells which may be expressed either at the plasma membrane or at membranes about the particulate cell fractions within the cells that contain the susceptible enzymes. More recently it has been shown that the reaction product between streptomycin and the nucleates of susceptible bacterial cells is different from that with mammalian nucleates (17).

RESISTANCE TO ANTIBIOTICS

In addition to specific differences in susceptibility of mammalian and bacterial cells the marked differences in susceptibility and resistance to antibiotics by micro-organisms complicates the judgement as to the safety of antibiotics in foods. Specificity of susceptibility to different antibiotics has already been mentioned. Each of these, in turn, is subject to differential manifestations of resistance between major taxonomic groups, between species of the same genus, and within strains belonging to the same species. The emergence of resistant progeny from a previously susceptible strain is, of course, one of the dangers attendant upon therapeutic use of antibiotics and, particularly in relation to the staphylococci, is a major threat to the continued clinical usefulness of any specific antibiotic. Further, it is known that induced resistance to one antibiotic may confer resistance to certain others (22). Fear of debasing the medicinal value of antibiotics through the emergence of resistant strains by their use in food was one of the more commonly voiced arguments against any such practice. Recent opinions suggest that these rationally founded fears have little support in experience (7, 8).

Much evidence exists in support of two mechanisms for the development of drug resistance. Induced resistance is widely considered to occur through a mutational change in the gene structure of a previously susceptible cell (5, 40). While not free from controversy, a growing weight of opinion favours the point of view that antibiotics do not themselves cause such gene changes but allow the selection and survival of the progeny of a cell which has undergone a mutation that by chance renders it less vulnerable to the particular antibiotic in its environment.

An alternative postulate supposes that resistance occurs through a physiological adaptation dependent upon the synthesis of adaptive enzymes which permit an alternate pathway for some essential function normally inhibited by the antibiotic (5). To what extent the two concepts may be interrelated, if at all, does not yet seem to be completely explained (22).

Of considerable practical significance, however, is the observation that the mechanism of resistance becomes manifest in two general "patterns", and that different antibiotics seem to have specific propensity for one or the other. Resistance within a bacterial culture may develop in a comparatively slow, progressive, step-by-step fashion whereby the majority of the surviving cells and their subsequent progeny possess a degree of resistance only slightly greater than the concentration to which they have been exposed. The tetracyclines are among the better examples of this type. Penicillin responds similarly. The second group of antibiotics, typified by streptomycin and erythromycin, have the ability to induce resistance to a high multiple of the exposure concentration after a few or, on occasion, only one exposure (22).

A wide difference will be recognized between the comparative hazard resulting from use of the respective groups of antibiotics in relation to emergence of resistant strains. Thus it seems reasonable to infer that a single exposure in foods, at the low levels recommended, to a member of the group characterized by a progressive development of resistance is unlikely to induce resistance to the much higher concentrations therapeutically used.

Antibiotic Resistance in Relation to Food Spoilage

Experience establishes that whenever the normal microbial-ecology of a mixed population is disturbed by any selective process, the risk arises that specific populations or species normally held in check by competitive microbial action may become dominant and their unimpeded growth may give rise to new forms of spoilage not normally encountered. The application of sorbic acid in order to control yeasts in pickles or cheese has led to previously uncommon spoilage caused by gas-forming lactobacilli in the former food and spoilage by clostridia in the latter. The development of staphylococcal enteritis in man as a sequel to prolonged antibiotic therapy may have comparable implication.

Similarly, since antibiotics would be an equilibrium-disturbing factor in foods, the occurrence of any such specific selectivity to an extent sufficient to cause economically important spoilage could soon invalidate the use of antibiotics for preservative purposes. However, it should be recalled that the microbial contaminants on each incoming consignment of untreated foods will normally have had no previous contact with an antibiotic, so that repetitive exposure to a particular antibiotic will not occur, and in the instance of the tetracyclines a high degree of resistance would not be expected to develop because of the progressive habit of development of resistance. Further, as pointed out earlier, it must be assumed that treated foods will receive satisfactory sanitary and refrigerative treatment so that "naturally" resistant organisms would not be exposed to an environment conducive to rapid growth with opportunity for spoilage within the limits of the extended shelf-life provided by the antibiotic.

These arguments could prove invalid if foods became severely contaminated with resistant spoilage organisms that may have become endemic in factories or their appurtenances, in ships, conduits, packaging facilities or workers' clothing. This could occur as a result of repeated exposure of the various surfaces to antibiotics and the possibility of high concentrations of an antibiotic developing at these sites due to repeated drying. Wooden equipment would offer a greater likelihood of such occurrence.

The foregoing considerations thus re-emphasize two important requisites:

(1) antibiotics which commonly induce "one-step" high level resistance should be avoided in foods and (2) a need for coupling high standards of cleansing and hygiene with any use of antibiotics as preservatives.

PATHOGENS IN FOODS

The general principles considered in relation to spoilage apply also to pathogens. If a resistant pathogen is already present in a food to be treated with an antibiotic, the risk must be entertained that the pathogen may be selectively favoured as a result of bacteriostasis of other species. This phenomenon has occurred, apparently sparingly, as the result of continued use of particular antibiotics in the feed of animals. This aspect is discussed in a review by Finland (8), who concludes that the use of tetracyclines for years in poultry and animal feeds has not given rise to undue problems from resistant pathogens. A recent extensive review by Hines (11) expresses a similar viewpoint.

Two instances of losses due to disease in specific poultry flocks have come to our attention in which contributory factors seemed to be the prolonged use of abusively excessive quantities of antibiotics in feeds as a lay measure for the treatment of a disease outbreak. A destructive outbreak of staphylococcal enterocolitis in chinchillas has also been reported, in which the staphylococci implicated were resistant to the antibiotic that had been persistently added to the animals' feed. The pathology of the infection resembled that found in post-therapy enterocolitis of man (38).

Studies with fish treated with chlortetracycline at commercially recommended levels gave no indication that staphylococci or *Clostridium botulinum* would be selectively favoured. The added populations of each were substantially reduced (27). Data are desirable, however, to show what would be the effect of tetracyclines on strains of these organisms already resistant. Such data would be even more pertinent to poultry, particularly with regard to staphylococci, for fish are not frequently implicated in staphylococcal food poisoning (23). Again, it is pertinent to recall that even if selectivity towards survival of resistant pathogens or food-poisoning organisms could be shown, it is necessary that treated foods should be processed and stored under favourable conditions of sanitation in order to secure any advantage from the preservative action of antibiotics. Such conditions imply that an environment conducive to the elaboration of toxins would not be permitted.

Strains of *C. botulinum* have been recognized that are resistant to nisin and subtilin, two antibiotics experimentally used as adjuncts to canning (2). This is a powerful argument against use of such antibiotics in those canned foods in which *botulinum* toxin can be formed.

TOXICITY OF ANTIBIOTICS AND RESIDUES

Because of the diverse nature and biological functions of the various antibiotics, the toxicity of each particular compound must be considered independently, though it is now recognized that oxy- and chlortetracycline are chemically and functionally very similar. The following comment on toxicity applies only to chlortetracycline and oxytetracycline.

An examination of the literature on the toxicity of the tetracyclines has been undertaken by the staff of this laboratory together with some appraisal of the expansive clinical experience that has been published. The literature has been reviewed with affinity for the viewpoint that no chemical should be added to foods for general use unless it can be shown to be non-toxic at the levels and under the conditions of use recommended or likely to be attained. Subsequently, an extensive review has been published by Hines (11) on the toxicity of chlortetracycline as revealed by studies of the administration of this antibiotic over prolonged periods to laboratory animals, poultry, swine, and man, with reference both to therapeutic usage and ingestion in feeds. The studies with man include as subjects premature and normal infants, children, adults and geriatric patients all in comparatively large numbers. Many of the authors whose work was reviewed, express lack of evidence for significant toxicity and Hines concluded that "there is no evidence to indicate that the prolonged oral administration of chlortetracycline to man or domestic animals is harmful at presently recommended dose levels". It should be recalled that levels recommended for application to human food are much lower than the dosage levels referred to for feeds or therapy. Hence, it seems reasonable to accept the thesis that tetracyclines applied to foods at the recommended rates would not be toxic *per se*.

The writer is unaware of any data on the nature of possible reaction products with components of food, but these would seem to involve only a low proportion of the antibiotic, if they occur, for the greater part of added chlortetracycline can be recovered in the form of a compound known as isochlortetracycline into which it is converted both in the intestine of the rat or when cooked in chicken meat. This substance has no antibacterial activity and its toxicity is of low order with a reported LD_{50} in mice of greater than 10 gm/kg (24). Several products of hydrolysis, under conditions probably not likely to be provided by ingestion of food, have been described during determination of the chemical structure of the tetracyclines. Some of these are naphthol derivatives, but whether these occur in foods is not known.

Carcinogenicity

The difficulty is recognized of postulating precise conditions that would warrant ascribing a clearly positive or negative property of carcinogenesis to a particular compound. In the absence of direct studies to investigate the carcinogenicity of antibiotics, the deduction has been made that clinical experience would have revealed any carcinogenetic propensities of these compounds if the ability to induce a cancerous condition were among their properties. No such evidence has been found. In a recent review of the hazards of antibiotics Bacharach leaves no doubt as to his opinion: "Even the most terrified carcinophobes have not yet suggested that any antibiotic is by any

route capable of evoking tumours in any animal" (1). Nevertheless, the need to remain watchfully alert is suggested by the report of Rubin *et al.* (21) to the effect that mice receiving antibiotic treatment during experimental transplantation of lymphosarcoma cells showed a higher incidence of successful transplants when using sparse inocula, and that tumours in resistant mice showed greater growth before demonstrating the normal tumour recession. Tetracyclines did not exhibit these properties.

Allergic Sensitivity

Penicillin has been shown to induce various allergic responses ranging from mild urticaria to severe anaphylaxis. Certain other antibiotics may also be allergenic but do not seem to be of such serious concern as penicillin in this respect. Weiner *et al.* (34) review eight fatal or near-fatal cases from penicillin administered orally, and conclude that "... the problem of anaphylaxis from penicillin by all routes of administration will be of increasing importance". This observation points to the desirability of excluding penicillin from foods, and is of particular significance in the antibiotic contamination of milk, to be considered later. In discussing antibiotics in relation to allergy, Rein (19) refers only briefly to the tetracyclines with the statement "... hypersensitivity to these antibiotics, even when applied topically, occurs infrequently". Such enquiry as has been possible indicates that for practical purposes the tetracyclines should be considered non-allergenic, since *bona fide* cases are extremely rare even among production workers or those who are in constant contact with the tetracyclines used in animal feed. Welch (36), however, points out that "constant handling can, in certain rare instances, sensitize", and refers to a known case of dermatitis from handling chlortetracycline, though accepts the observation that any aromatic substance might react to this degree.

Effects of Antibiotics on Intestinal Flora

Several reviews are cited by Finland (8), Sieberth *et al.* (25) and by Combs (6) on the effect of antibiotics on the intestinal flora of poultry and cattle, and to a lesser extent, of man, with the general conclusion that the modifications that are known to be induced by the tetracyclines at low levels seem to be beneficial.

The lack of evidence to suggest that the qualitative modifications of intestinal flora have any adverse physiological effect (11) should be appraised in the light of the now common clinical finding that continued use of an antibiotic may allow the selection of antibiotic-resistant pathogens, with subsequent development of several manifestations of moniliasis or of staphylococcal gastroenteritis. It is true that these diseases have been associated with the use of antibiotics at dosage levels much higher than recommended for use as food preservatives, but such occurrences are basic to the argument for the preferable restriction of the level of antibiotics tolerable in foods to those amounts which are destroyed during cooking. That this occurs is well established for poultry treated under commercial conditions and is the dominant finding for cooked fish. The skin of treated fish cooked by several methods may still contain traces of chlortetracycline, and after baking or frying both intact

or filleted fish may reveal small residual levels which as recorded by Tarr and co-workers (4) range from 0.02–0.13 $\mu\text{g/gm}$. There is no evidence to suggest that any harmful effect can be expected from such minute amounts. Indeed, experience with the ingestion of much larger amounts is to the contrary.

ANTIBIOTICS IN MILK

The occurrence of antibiotics in milk is an artifact arising from the use of antibiotics for the control of bovine mastitis followed by use of the milk from treated cows within a period of time less than 72 hours after the last treatment.

In Canada, a local survey of fluid milk conducted in 1952 showed that 7.3% of milk specimens contained inhibitors to *Streptococcus lactis*, and 1.4% contained penicillin in excess of 0.05 I.U./ml (13). A more recent survey in the United States (35) showed that in 1956, of 1,706 market specimens of milk, 5.9% contained penicillin at values up to 0.55 units/ml. This represents up to 550 I.U. per litre. According to a panel of some thirty specialists, as reported by Welch (37), the residual penicillin was not considered to be a hazard to the health of consumers either by the likelihood of developing resistant pathogens, through modification of intestinal flora, or by sensitizing non-sensitive people. The opinion was expressed, however, that the contaminant penicillin in milk might well evoke allergic reactions in extremely sensitive individuals. Fatal anaphylaxis from reaction to penicillin administered orally has already been mentioned, though established reactions from the small quantities of penicillin in milk are rare at present.

An existing regulation of the Food and Drugs Act requires that the label of antibiotic preparations designed for the treatment of mastitis "shall carry a warning to the effect that milk from treated quarters should not be used for human consumption or marketed for cheese for at least 72 hours after the last treatment". While the drug manufacturers comply, it is clearly evident that many milk producers ignore or are not aware of the warning. In particular, this is apparent in the manufacture of cheese where inclusion of milk containing antibiotics is shown to cause substantial losses from three causes: (a) failure of "starter cultures" to produce sufficient lactic acid to coagulate the casein; (b) slow development of curd resulting in low quality cheese; (c) cheese apparently satisfactory when first graded becoming "down-graded" during storage as a result of abnormal physico-chemical or microbiological changes. These effects have been the experience within Canadian industry, though a recent British paper while reporting the presence of penicillin in 3.4% of milk "pools" destined for cheese, noted no correlation between the amount of penicillin in milk and the grading of the cheese (16). The present antibiotic preparations most generally in use in Canada are mixtures selected from penicillin, dihydrostreptomycin, chlortetracycline, neomycin and sulpho-namides with others such as bacitracin and polymyxin less frequently. The more common dosage range of penicillin among commercial preparations is from 250,000 to 1,000,000 units. The use of up to 2½ million units in a single application has been reported.

The favoured use of penicillin has led to other effects. We have been assured by veterinarians in authoritative positions, that while the frequency

of deaths from gangrenous conditions developing from mastitis seems to have been reduced by the use of penicillin, the incidence of chronic mammary infection remains at least as high. Mastitis ranks among the three most common bovine diseases. It is recognized that other factors such as those associated with management for intensive production, and traumatic factors including the inflammatory effects of poorly operated milking machines may be contributory to udder infection, but statements have been made by authors from several countries to suggest that in the etiology of the disease the penicillin-vulnerable mastitis organism, *Streptococcus agalactiae*, tends under the influence of antibiotic treatment to give way in numerical importance to the staphylococci.

The high rate of induced resistance among the staphylococci is well appreciated. This trend has been under observation by this laboratory for some years. After having established that coagulase-positive staphylococci were common both in cheese and in the milk used for its manufacture (30) it was shown that a substantial proportion of these organisms were penicillin-resistant (28). On conducting a survey in 1953 of the distribution of phage types among these staphylococci and comparing representative isolates with those from clinical infections in hospitals, it was established that the milk- and cheese-borne staphylococci were dominantly of phage group IV, considered to be of bovine origin and of infrequent cause of infection in man (29). They are, however, known to be capable of causing food poisoning. More recently Robertson *et al.* (20) have reported that milk in Saskatchewan not only contains a high incidence of penicillin-resistant staphylococci, but among them are the notorious phage type 81, not infrequently endemic in hospitals and shown to be capable of becoming highly virulent.

This laboratory, during the past year, has noticed a changing staphylococcus flora in milk elsewhere in Canada. Members of phage group IV remain common, but in addition, from milk delivered to a single cheese factory, isolates were obtained with phage patterns not incompatible with a possible "hybridization" between members of group IV and group III, while a number of isolates were characteristic of the representatives of group III of common clinical significance in man, including type 81, together with a few isolates in group I. A second trans-Canada appraisal of staphylococci in cheese is in progress. Reports of staphylococcal food-poisoning from "American" (i.e., U.S. cheddar type cheese) have been brought to our attention within the past few months, while in the same period, this laboratory has established the presence of enterotoxin in specific Canadian cheese specimens that also contained coagulase-positive, hemolytic and enterotoxigenic staphylococci of phage-groups III and IV.

Thus a problem is posed having three main aspects: (1) the need to reduce the amounts of penicillin in milk because of the allergy hazard; (2) how to exercise effective control of mastitis without serious encouragement of the development of antibiotic-resistant staphylococci of phage types generally virulent to man; (3) how to minimize the dissemination of staphylococci in cheese. A clearer insight to an approach would be possible if it were known to what extent, if at all, the consumption of food containing staphylococci (sometimes to the extent of several million per gm) could allow these or-

ganisms to become established in the throat, for recent studies have shown that type 81 may exist for months as a commensal organism in the human nasopharynx, but, in response to predisposing factors, eventually may become actively pathogenic.

No simple solution is in sight. To revert to the former practice of requiring a veterinary prescription for each sale of antibiotics intended for use in the control of mastitis would be of dubious value and for reasons too many to enumerate here. If penicillin dosage levels were to be regulated, as is currently "on trial" in the United States, several effects could be expected that might well counter-balance any possible advantage from a slightly reduced risk of rare allergic reactions. For instance, limitation of penicillin concentration in a dosage unit would be expected to lead to alternative use of higher levels of other antibiotics or the use of multiple dose units of penicillin for a single treatment. Other antibiotics are just as inhibitory to cheese starter-cultures and the staphylococci would be expected to develop resistance to these other antibiotics as has been so well established in human medicine. The suggestion has been made that low levels of penicillin (100,000 units is the U.S. limitation) might even favour the more frequent selection of resistant organisms. Furthermore, the enforcement of such a regulation operative in every cowbarn has many inherent difficulties, even allowing for a substantial degree of response to education. It is known that a number of Canadian cheese manufacturers offered to pay to their patrons the full price of milk if it would be withheld from the factories when suspected of containing antibiotics. This policy met with no response. The present easy availability of antibiotics from many sources, including the ubiquitous feed merchant, and the farmers' attitude towards the use of antibiotics as established by a "barrage" of advertising and by his observation of veterinary practice also should not be overlooked. Other aspects have been raised. The total complex problem will need imaginative action. Preliminary reports (unpublished) of a dye that could be incorporated successfully in preparations for use in mastitis and which will stain the milk of treated cows for a period of 72 hours, carry a note of encouragement for control of residual antibiotics though this may have little bearing on antibiotic resistant staphylococci.

CONCLUSIONS

The foregoing discussion and its supporting literature point to a number of conclusions pertinent to the presence of antibiotics in foods for use in Canada.

A. Antibiotics as Preservatives

The only antibiotics likely to satisfy reasonable requirements for use as preservatives in foods are those with the following properties. They (a) have a demonstrated effectiveness under commercial conditions and under the environment provided by normal storage methods; (b) are stable in the foods for which they are recommended and under normal conditions of storage of those foods for periods sufficient to exercise effective bacteriostasis; (c) possess a "broad-spectrum" antibacterial action; (d) are non-toxic within acceptable limits of safety; (e) demonstrate no common propensity at low levels to induce "one-step" high level resistance among a microbial population; (f) are non-

carcinogenic within a practicable interpretation of the term; (g) are non-allergenic beyond a degree of rare eccentricity.

Antibiotics should be allowed only in those foods for which social custom involves cooking as a normal practice and in which for practical purposes, cooking destroys the antibiotics contributed by recommended commercial treatment. It is questionable how absolute may be the interpretation of the destruction by cooking. It will depend in part upon sensitivity of available methods and upon decision as to what constitutes a level of survival that has any biological significance.

Legislation enabling the use of a specific antibiotic in foods should be subject to repeal in the event that commercial usage provides evidence of a significantly increased incidence of antibiotic-resistant or naturally non-susceptible pathogens arising from such usage, or if their microbiological selectivity gives rise to an economically significant degree of new or "abnormal" spoilage. It is deduced that the probability for such occurrence is remote, but contemplation of corrective action is a precautionary measure.

Antibiotics should be used as preservatives only under careful surveillance to minimize misuse and abuse. This aspect warrants extensive educational action.

Any attempt to "defraud" by over-extension of the shelf-life of appropriately treated and labelled foods should be subject to strict surveillance by food-control agencies.

Each antibiotic proposed for use in foods must be considered on its individual merits in relation to the purpose for which it is recommended, the public health aspects of its usage, and its continued value in the medical field.

The use of antibiotics in foods should be coupled with increased effort to improve the practices of sanitation and hygiene related to the production, processing, and marketing of the foods. This will be a critical factor in effectiveness and in safety.

The available evidence suggests that for practical purposes the foregoing requirements are met in Canada, subject to control of sanitation, without any determinable hazard to health by the allowance of chlortetracycline or oxytetracycline as preservatives in poultry or in fish provided that the concentration of the antibiotic in the raw food does not exceed seven parts per million in poultry or 5 p.p.m. in fish, and provided that treated foods are clearly labelled to that effect. Accordingly, the Regulations of the Food and Drugs Act have been so amended.

B. Antibiotics in Milk

The prevalence of antibiotics in milk points to widespread carelessness in the sale of milk from antibiotic-treated cows. From this has arisen an economic problem in cheese manufacture, and some risk that milk contaminated with antibiotics may cause severe anaphylactic reactions in highly sensitive individuals. Further, the commonplace use of antibiotics for the control of bovine mastitis seems to be associated with the dissemination in unpasteurized dairy products of antibiotic-resistant staphylococci. The cow appears to have become a source, with some evidence of a growing frequency, of strains of staphylococci usually associated with human pathogenicity and including those lysed by phage type 81, currently of major significance in hospitals.

The problems of antibiotic residues and antibiotic-resistance of staphylococci from bovine sources seem inseparably associated with the control of mastitis. Action to meet this problem would be timely.

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Rehabilitation in New Brunswick¹

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THE aim of any rehabilitation program is to restore disabled persons to the greatest physical, mental, social and economic usefulness of which they are capable. It is based on the realization that medical skills can often combine to reduce or eliminate disability, that prosthetic appliances can increase the capacities of the individual, and that if the latent skills of the disabled are developed many can become productive members of society and live satisfying and useful lives. If suitable techniques are applied as soon as possible after it is known that injury or disease will lead to permanent disability, the period of convalescence may be reduced, the degree of disability minimized and complicating emotional factors avoided. This approach emphasizes convalescence and recovery and the optimism that these engender in the disabled, and substantially lowers the cost of treatment and the economic burden that so often result from dependency caused by disablement.

The first move towards a rehabilitation program for disabled civilians in Canada took place in 1951 when a conference was held in Toronto to discuss the need and possibilities of setting up such a program. Representatives from voluntary agencies, the federal government, provincial governments, employers and labour groups met to study the problem. It was found that there was a variety of rehabilitation services available to specific groups of the disabled through the Department of Veterans' Affairs, Workmen's Compensation Boards, voluntary agencies concerned with the blind, deaf, arthritic, tuberculous, etc. and the Special Placements Division of the National Employment Service. There were, however, wide and serious gaps in the service offered to certain categories of the disabled. In addition, there were many disabled persons who were without any service and a complete rehabilitation service was available to a very limited number of people. There was a great need to co-ordinate services so that a complete program could be extended to all the disabled and to ensure that no disabled person was lost in referral between services. As a result, in 1952, a national co-ordinator of rehabilitation was appointed to organize a program for all the disabled of the country; since that time provincial co-ordinators have been appointed in nine provinces.

Action was taken first at the federal level. A medical rehabilitation grant was provided by the Department of National Health and Welfare for services to the disabled not available from any other federal health grant. One million dollars annually was made available to the provinces (New Brunswick's share was \$42,000) to assist in the training of medical rehabilitation personnel such as physiotherapists, occupational therapists, rehabilitation officers, etc. and for the purchase of equipment. Money could not be used for the purchase of

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services to individuals. The Department of Labour provided a co-ordination grant of \$15,000 to each province to assist in the cost of employing a co-ordinator and staff. It also made available vocational training grants to the provinces to assist in providing vocational training for the disabled. In addition, the National Employment Service offered placement services for the disabled in all provinces.

In New Brunswick, two modes of procedure were open to us. We could conduct a case-finding survey to discover those who needed rehabilitation and then work toward making the needed services available and when all was ready provide a complete rehabilitation program; on the other hand, we could extend what services were available to those who could benefit from them and try to expand the service so that a greater number of people and all disabling conditions could be covered. Acting on the advice of the national advisory committee, we adopted the latter course. With the introduction of the disability allowances program we felt that many of the disabled would be discovered and that there would be no need to search for new cases for some time to come. We believed also that available services should be utilized to the full extent by as many as possible. We began immediately to train physiotherapists and occupational therapists and to purchase equipment for the Polio Clinic and other hospitals where it was possible to carry out physiotherapy services.

Vocational Training

In the field of vocational training, representations were made to the Department of Education to implement the operation of Schedule R, Training Program for Disabled Persons. This was done in July 1954 and training was commenced. Under this schedule, those disabled persons who require special help and who, after medical and vocational assessment are approved for instruction, are trained for a trade in which their disability is not a serious handicap. The selection committee is composed of J. W. McNutt, Director of Vocational Education, B. W. Kelly, Director of Apprenticeship, A. C. Ross, Regional Supervisor of Special Placements, National Employment Service, and G. W. Crandlemire, Provincial Co-ordinator of Rehabilitation. Under this program, training is provided at the New Brunswick Technical Institute. If training is not available there it is possible to send persons elsewhere for training. Transportation is provided to and from the school and tuition fees, textbooks and living allowances are paid. If necessary, daily taxi fare can be provided.

In the field of job placement, services in New Brunswick are limited. Full time special placement officers are located in Saint John and Moncton and a part-time officer in Fredericton. In other centers special placements are handled by regular placement officers but they have not time to give effective service to disabled persons. As a result, placement in most areas is done by our own staff with local co-operation. The vocational training phase of our program has been more fully developed and better results achieved. In fact, the latest figures issued by the Director of Vocational Training for the federal Department of Labour indicate that we compare most favourably with the other provinces in this field. We have been able to place those we have trained

without any difficulty and, with the help of the National Employment Service, have placed a number of others who were employable without further training.

Medical Rehabilitation

In the medical phase of the program we had to be content with referring new cases to available services such as the Polio Clinic or the tuberculosis hospitals or, with the financial assistance of service clubs or other sources, to pay for medical treatment. We have done this in a number of cases with most satisfactory results but this part of the program developed slowly. In the first two years of operation we were able to rehabilitate to gainful employment over 300 disabled persons and during 1956 we closed 168 cases as successfully rehabilitated. We are, of course, far from satisfied but it was encouraging to hear from the National Co-ordinator of Rehabilitation that we are keeping pace with other provinces in Canada.

In January 1957, after considerable negotiation, a program of medical rehabilitation services was started. The federal government, through the medical rehabilitation grant, contributed to the program an amount somewhat less than 50% of the cost of the program. Our medical rehabilitation program operates for those who are recommended for medical treatment by our rehabilitation assessment team and who have shown positive indication that they will be able to enter employment after receiving this service.

Services which the Department of Health and Social Services has agreed to extend to individuals include medical assessment by the medical assessment team or by private doctors with hospitalization up to a maximum of one week if necessary. The cost of any medical or surgical treatment recommended in this assessment will be paid by the provincial government as well as hospitalization charges up to a maximum of sixty days. Prosthetic appliances recommended by the assessment team will be provided free of charge to the individual. No transportation costs are to be paid. Any outpatient physiotherapy treatment will be provided at the Polio Clinic and Health Center and in other hospitals of the province where the service is available. An outpatient allowance of \$40 per month can be paid to those living away from home who are not receiving the disability allowance. Some priority will be given to those referred by the disability allowances board and the number to be accepted must be limited to those who have definite employment possibilities. Later the program will expand, as the demand for medical rehabilitation services is increasing rapidly.

Developments in Services

A rehabilitation center will be opened in Fredericton in the late fall and we are most hopeful that this will provide a badly needed service and that others will be built in other parts of the province so that medical rehabilitation facilities will become available to all who can benefit from them.

We have had discussions with officials of the Department of Veterans' Affairs recently and we are confident that the services of the Rehabilitation Center at Ridgewood can be used and this will assist us greatly.

The New Brunswick Correspondence School has offered its services to all the disabled and the D.V.A. correspondence courses have also been made available to us.

Unsolved Problems

Perhaps the biggest problem is lack of staff. We are told by the national office that the case load should vary from 30 active cases per field worker in a large area to 100 for a small, thoroughly serviced area. We have one worker for an active case load of over 500.

We are often severely criticized for not publicizing our program more. We have fallen down badly in this respect but already we have many more cases than we can handle and we are not trying hard to find new ones. We have spent what time we could publicizing our program.

Repeated representations have been made to the Unemployment Insurance Commission in Ottawa to increase the number of special placement officers and to provide time for them to work outside their office. So far, we have not been successful in this respect but we will keep trying.

We need more active and wider employer co-operation in hiring the disabled. No one hesitates to admit that disabled workers are probably as efficient, more dependable, more permanent and more anxious to please than the average worker, and everyone admits they should be given a chance to prove their worth, but there is still considerable hesitation about actually giving them a job, especially if the disability is very much in evidence or might require some small readjustment of working conditions. This is in no way the least noticeable in the government service where I feel we should have the greatest co-operation. It seems to me that if a government sponsored rehabilitation program is to succeed, the government service should be readily accessible for employment. In fact, our selection committee for Schedule R went on record as favouring preference in the federal and provincial civil service, next to veterans, for disabled persons referred through the rehabilitation program. We wrote to the National Co-ordinator asking him to give his opinion on the subject and he replied reaffirming that disabled persons should be treated on exactly the same basis as ordinary employees and hired or retained without preference or prejudice, and that he was opposed to any policy of hiring the handicapped out of sympathy for them. This is all very well if it would work. We feel, however, that there is bound to be some prejudice and hesitancy about hiring a handicapped person and that if preference were given in making jobs available, not on the basis of sympathy but as a means of equalizing or neutralizing the handicapped in jobs for which they are fully qualified, then nothing more than justice would be done. They would still have to prove their ability to do the job, no sympathy or special consideration being expected or desired in retaining them or placing them in a job for which they were not qualified or efficient. We feel that the initial opportunity should be made more widely available.

Our rehabilitation program is growing steadily and more and more services are becoming available. A co-ordinating council has been formed seeking to co-ordinate not only rehabilitation services but all services to the disabled and I feel confident that a new world of opportunity is opening up for the disabled. I believe that in the not too distant future, it will truly be the ability, not the disability, that will count.

The Need for Research in Accident Prevention¹

CHRISTIAN SMITH²

IN 1953, the Saskatchewan Department of Public Health invited its director of health education to consider what was to be the first home safety education program initiated by a Canadian health department. Shortly after this program was launched it was broadened to include farm safety as there was no other provincial agency interested in this problem.

There was no Canadian precedent upon which the department might lean with the exception of two fairly recent surveys by a large insurance company among its Canadian policyholders. Obviously, neither the data collected by the company, nor challenging statistics on the American accident scene could be accepted as applicable to Saskatchewan.

SOURCES OF DATA

Death Registrations proved to be the simplest and most available source of data in the province. Individual study of every death certificate of 1952 yielded sufficient data to indicate that there was indeed a problem of accident mortality. The statistics immediately stimulated more questions and it was apparent that this should be an area for research. From year to year the health educators have continued to consult the death registrations. This source has some serious limitations, but one must be content with the assumption that the accidental fatalities recorded are at least a minimum. To go to the public with the statement that there were at least 400 fatal accidents is better than saying nothing because the mortality may have been greater.

The difficulty has been that physicians do not necessarily ascribe death to an original injury but sometimes attribute it to a complication. Thus, in a case that was studied by health educators, a man who was admitted to a hospital with a spinal fracture and died three weeks later of pneumonia, was listed as having died of pneumonia. Recently, another case was followed. A distinguished member of the bar, who was known to have fallen downstairs, was taken to hospital by ambulance, treated for a considerable period in the emergency ward, and died. His death was ascribed to cerebral haemorrhage. Whether this caused the fall or resulted from it remained undetermined and no inquest was held. The Division of Vital Statistics classified the death as having been due to a cerebral haemorrhage. The Health Education Division took note of it as a fatal accident.

The statistics compiled from death registrations were used first to convince the department's own staff and the public health personnel through the province that the problem of fatal accidents demanded their attention. On the

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information, sparse as it was, the in-service training of medical health officers, public health nurses, sanitarians, and others, was based. It was a little later that the information was forthcoming that accidents were the leading cause of death in the age-group 1-35 in Saskatchewan.

The next step was to discover how many non-fatal accidents occurred in Saskatchewan. There was then, and there still is, no accurate way to ascertain the number. One had to use the ratio employed by the (U.S.) National Safety Council which, on basis of a number of studies, concluded some time ago that there are at least 75 non-fatal accidents for every fatality; in some surveys the ratio was higher. It may be well to state, also, that the National Safety Council defines an accident as an unexpected occurrence which results in injury incapacitating the victim for normal pursuits for 24 hours or longer.

On the basis of an average of 411 accidental deaths in Saskatchewan yearly in the period 1951-56, there are more than 30,000 such non-fatal accidents every 12 months.

The Saskatchewan Hospital Services Plan covers virtually the entire population of the province. In 1952, the Plan paid the hospital bills of 13,268 accident victims. In the period 1951-56 there was an average of 13,376 victims per year covered by the Plan. This Plan is concerned only with in-patient care. Obviously, many injuries and disabilities resulting from accidents are treated at home, in doctors' offices and clinics, and in hospital out-patient departments. The S.H.S.P. experience is indicative only of hospitalized patients. Nonetheless, the information was valuable in the educational program.

There are, of course, people to whom economic factors appeal more strongly than humanitarian implications, although it can be demonstrated that the loss of a life or the mutilation of a farmer has its economic aspects as well as humanitarian. In the five years reviewed the people of Saskatchewan, through their hospitalization plan alone, paid \$6,521,163, or an average of \$1,304,232 per year. Such figures have been used with reminders that the medical expenses, loss of wages, loss of earning power, loss of a breadwinner and social assistance would easily aggregate at least as much again.

At the beginning of 1957, S.H.S.P. introduced a new report form devised by the Research and Statistics Branch and the Health Education Division of the department. Hospitals this year are being asked to submit a completed form on every admitted hospital case. There is reason to believe that the hospitals are not as co-operative as might be desired. If reporting is not complete and universal an excellent source of information will remain unavailable, although it will be possible to base some conclusions on the sampling received. The form calls for information on date, type, and locality of each accident, and there is space for a description of the accident and the signature of the patient or his guardian.

The Medical Services Division of the Department of Public Health could be a helpful source of information as it pays the medical, hospital, pharmaceutical, and appliance expenses of a large number of individuals benefiting from public assistance programs.

The Department of the Attorney-General receives police reports following investigation of all sudden and violent deaths. Its interest is purely legal, the purpose of police inquiry being to determine responsibility and possible culpa-

bility. It was noted that the Department of the Attorney-General received reports from the Royal Canadian Mounted Police on all its investigations of this nature. Examination of these police reports showed them to be lacking details important to the Department of Public Health. Representations made to the police authorities resulted in excellent co-operation. A form was drawn up for the use of officers investigating all farm fatalities. These are routinely used, completed, and sent to the Health Education Division. Names are given to identify individual reports but are not used otherwise.

The information the police obtain includes classification of the type of accident, name, age, marital status of the victim, the number of dependents, time, date, place of accident, and date and place of death. In separate columns there is further information about the kind of place in which the accident occurred, i.e. field, road, yard; information about weather, light, and terrain. There is further space to identify the machine which may have been involved in an accident, and finally more questions about the victim, such as possible previous physical disability, fatigue, and previous accident experience.

AN APPROACH TO THE PROBLEM

These, then, are the sources from which the health educators obtained such facts as they could. These data were matched against data from other areas, and considerable similarity was noted. It was found that home accidents caused the greatest number of fatalities from 1951 to 1955 inclusive, with motor vehicle fatalities a poor second. It was found that among the victims of home accidents children and the aged were most commonly involved. The health educators noted that in the United States generally, motor vehicle and traffic deaths lead, but that New York City has found the home more dangerous than the street.

Last year, in Saskatchewan, motor vehicle fatalities were more numerous than those in the home. It would be difficult to determine the reason. It is too soon to make any claims for the safety program. Indeed, it may never be possible to say that a reduction in accidents has been the result of educational effort, but it is known that in Saskatchewan the number of home and farm accidents has been reduced year by year since the educational work began.

One of the immediate objectives of the Health Education Division was to create public awareness of home and farm accidents as a frequent cause of death and disability. The traffic safety people have conducted their publicity so intensively that the mind of the average man immediately visualizes "highway" or "crash" when the word "accident" is mentioned.

The second phase has been the participation of a large number of people, a procedure prompted by the well-known principle of involving people in their own education. This is still continuing, but even more important to the soundness of the department's program is its own developing interest which is gradually being achieved. The utilization of the department's research staff is vital, because health educators lack training and aptitude for statistical analysis and presentation. In this area the health educators must look to others on the public health team in the same way that they look to the others to suggest policies with respect to immunization procedures. The Health Educa-

tion Division had to function in virtual isolation for a considerable time before productive liaisons could be developed. Much of the value of statistical data, particularly with respect to prevention of non-fatal and non-hospitalized accidents, will depend upon the growth of co-ordinated effort.

Here is an example of one field of activity we have barely entered: In the Swift Current Health Region there is a universal prepaid medical care program paid out of taxes—the only one of its kind on this continent. All physicians' calls in home, hospital and office are recorded by diagnosis. These data are examined in many ways to obtain information on the pattern of medical care where the financial deterrent to medical care is removed. Recently, the data have been utilized in another way—to assist health officers in conducting specific preventive programs. The medical officer of health of the Swift Current Health Region was confronted with an increase in infectious hepatitis. He embarked on the widespread use of gamma globulin for the prevention of secondary family cases. Conscious of the delays and incompleteness in the official notification procedure, he was able to gain early knowledge of primary cases from the daily medical account forms of the practising physicians. In this way, preventive inoculations of secondary family contacts were given by public health nurses or family physicians in a comprehensive and organized way.

We foresee the day when we shall be able, in a similar way, to develop procedures jointly so that current data on non-fatal and non-hospitalized accidents are made available for use in an organized and intelligent way. Then the health education programs can be keyed to the actual problems as they exist. But the opportunities must be seen before they can be grasped.

We should also like to study hospitalization data to determine, first of all, the causes for regional and socio-economic differences in the incidence of various types of accidents. We have already learned that the phenomenon of the "accident repeater" is real, but we do not yet know whether the patients who come to hospital once or twice a year because of accidental injury are hurt because of job factors, home and other environmental conditions, or psychological factors. Nor do we know precisely what physical factors enter into accident experience, for example, the failing co-ordination and sensory capacities of older people. Here again, as detailed data become available, they can be used to sharpen the tools of prevention by pinpointing important areas in safety education. Without further research and statistical study much time and money could be expended where least needed.

It is possible that the collection of data on accidents may be susceptible to the newer statistical techniques, such as random sampling. I suggest that this is an area which merits the serious consideration of those who are skilled in statistical work. There is a need for teamwork which will include the efforts of statisticians and epidemiologists in the great modern public health task of preventing injury and saving lives endangered by accident hazards.

Bulk Milk Tanks

G. C. MILES¹

BULK tank milk handling started in California about fifteen years ago. The program moved slowly until about 1950 but today it has reached large proportions. In Canada, the first bulk tank route was started in British Columbia in 1952 and the next in Oshawa, Ontario, in 1953. The system has developed rapidly in Ontario since that time. In 1956 Alberta started its first tank route in the Edmonton area followed by one in Lethbridge and the movement is spreading rapidly in the province. In Manitoba one Winnipeg dairy plant started a bulk milk tank route in 1956.

It is recognized that the bulk tank system is one of the greatest advances made in the marketing of milk. It is a boon to producer and processor alike and where it is in operation has increased co-operation and understanding among producer, processor and the local health department.

Construction of Bulk Milk Tank

A bulk tank is a stainless steel tank for the reception of milk over which is applied a refrigerant and a layer of insulating material covered by an outside shell of stainless or painted steel. The equipment includes, of course, a refrigeration compressor and automatic controls. The cooling of the tank is achieved by either of two methods: (a) by the direct expansion of freon gas in the tank evaporator affixed to the bottom or side of the stainless inner lining; (b) by refrigerated water being pumped against the outside surface of the stainless inner lining. This cold water is produced by an ice bank which is built up in the bottom of the tank in an area between the inner stainless steel lining and the outer shell. By circulation the ice is melted and in the process provides cold water for cooling.

All tanks are manufactured to U.S. 3A standards which insures that correct materials are used, agitation is governed and correctness of calibration assured. Each tank must be equipped with a thermometer.

Basic Operation of Bulk Milk Tank

When the tank is scrupulously clean and sanitized the first milking is put in the tank by pouring the milk into a strainer, with filter disc, the strainer fitting into an opening in the cover. Alternatively, the tank may be used with a pipeline milker from cow to tank. The milk is cooled and the refrigeration equipment and agitator shut off by automatic controls.

The second, third and fourth milkings go into the tank and are cooled. There is no reason to believe that the addition of the warm milk or successive milkings, into the cold milk of the previous milking, creates any problem. While the warm milk is being added, the cooling is in process and the agitator is

¹Manager, DeLaval Company, Winnipeg, Manitoba.

working. The whole mass of milk for subsequent milkings should never rise above 50° F. When the cooling cycle is completed the milk is ready for the pick-up tank hauler. Since each tank is calibrated it is relatively simple to determine the amount of milk in the tank by using a measuring stick. On arrival the hauler removes the measuring stick from the tank, rinses it to remove foam, etc., wipes it dry and places it in its position on the tank. Then by removing it again and noting the milk mark on the stick he records the volume. A plastic-coated wall chart in the milk house and at the dairy plant indicates how many pounds of milk there are in the tank according to the reading on the stick.

The agitator is then started and 3A standards require that the whole body of milk in the tank be agitated to the degree of assuring homogeneity within five minutes of operation and so that the fat content determined at different levels in the tank and at extreme distances from the source of agitation will not vary more than plus or minus 0.1% butterfat through the capacity volume. After agitating an individual sample is taken and the milk checked for odours and flavours. The sample is placed in a refrigerated compartment in the tank truck. The hose from the tanker pump is then passed through the self-closing port and connected to the bulk tank and the milk pumped out. It is the responsibility of the hauler to rinse the tank thoroughly when empty.

When it became possible for milk to be measured in the tank, the sample taken and the milk pumped out, the method of buying milk at the receiving platform of the dairy plant changed to the method of buying milk on the farm. This was a radical change and the reason why so much emphasis must be placed on grading and measuring.

Advantages to the Farmer of Bulk Milk Tanks

Milk is picked up only every other day. This means washing the tank only every two days and the elimination of the cost of milk cans and their handling.

The agitation in the tank insures proper samples for the butterfat test. Losses through spillage are eliminated.

Since he can check the measuring stick himself he can always tell how much milk is in the tank whether or not he is there when the milk is picked up.

Having the milk picked up every other day means lower hauling costs.

The milk has been cooled quickly and held in a clean, sanitary, stainless steel receptacle and its quality is thereby improved.

The farmer knows that if his tank of milk is off flavour it can spoil perhaps 2,000 gallons of milk and is therefore constantly on guard. Furthermore, a rejection by the hauler can be costly when two days' milk supply is involved.

When buying milk on the farm the truck hauler is the most important member of the team and must be able to:

Check and identify abnormal flavours in milk.

Determine accurately the volume of milk.

Sample milk correctly for butterfat and conduct other laboratory tests.

Handle and transport milk in a sanitary manner.

Suggest good sanitary practices for milk production.

To instruct the haulers the University of Missouri, Department of Dairy Husbandry, commenced a two-day course in 1954. Because of the large amount of information given in the course all subject matter is mimeographed and given to each hauler for further study. Each group or class is restricted to 15 or 20 to permit discussion of individual problems. It is recognized that this course does not qualify a hauler as a sanitarian but should enable him to recognize poor sanitation practices. Generally, in the United States, besides careful checking of milk in the laboratory, a field man rides with the hauler at intervals to check his practices.

Quality Control of Milk in Bulk Tanks

The bulk tank must be washed each time it is emptied and newly installed tanks require a special cleaning treatment before use. In the regular cleaning of tanks, the problem is not milkstone but protein which requires special cleaning methods. The areas under the bridge of the tanks, the outlet valves, and agitators require close attention and the design of the tank is important to insure its remaining closed insofar as possible after sanitizing. Facilities must be available for the hauler to wash and dry his hands. The tank hauler must give all surfaces of the tank a thorough rinsing as soon as the tank is empty and for this, hot and cold running water under pressure are imperative. Each producer should have printed instructions relative to cleaning, sanitizing and general operation posted in the milk house. The location of the tank, size of the milk house, drainage and ventilation, etc., are all important. The tank thermometer must be checked regularly and inspections must be made to insure that all equipment meets code requirements. This is important as improper procedures of poor operators may be obscured by the mixing of their milk in the hauler's tank with that from properly operated farms. Grass and feed flavours may be masked when milk is very cold so great care is required in feeding.

HEALTH LEAGUE OF CANADA—37TH ANNUAL MEETING

ROYAL YORK HOTEL, TORONTO, FEBRUARY 13-15

Religion and Health, the Practice of Medicine, and Prevention will be the subjects of panel discussions at the annual meeting of the Health League. Other topics will include haemophilia, diabetes, epilepsy, and the diseases of childhood.

The luncheon speakers for the three days will include Dr. Arthur Kelly, General Secretary of the Canadian Medical Association who will speak on The Relationship of the Medical Profession to Voluntary Health

Organizations, Dr. Wilson G. Smillie, former Professor of Preventive Medicine, Cornell University on The Integration of Prevention in the Practice of General Medicine, and Dr. Robert Collier Page, Consultant in Manpower Development, on The Significance of Industrial Medicine.

Saturday, February 15, will be devoted entirely to the subjects of industrial health, geriatrics and mental health.

Canadian Journal of Public Health

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HONOURING DR. GASTON RAMON

Canadians will be very pleased that Dr. Gaston Ramon, to whom the world owes diphtheria and tetanus anatoxins (toxoids) and the knowledge of bacterial anatoxins and anaviruses, was honoured last spring with the high rank of Grand Cross of the Legion of Honour of France. Canada was the first country to honour Dr. Ramon with the conferring on him by the University of Toronto of the honorary degree of Doctor of Science in 1927. Canada, too, was the first country outside of France to prepare and to use Ramon's diphtheria toxoid, replacing the less satisfactory toxin-antitoxin mixture. Within a year of Ramon's introduction of toxoid in 1923, Dr. P. J. Moloney prepared quantities of diphtheria toxoid in the Connaught Medical Research Laboratories under the direction of Dr. J. G. FitzGerald. Through the co-operation of the provincial departments of health, the use of diphtheria toxoid was quickly adopted. The virtual elimination of diphtheria in Canada has been achieved and the great menace of diphtheria removed. Diphtheria control throughout the world was made possible by Ramon and, through his discoveries, tetanus deaths also have been prevented in every country, in days of peace and of war.

Ramon's contribution to preventive medicine places him among the very first of the world's great benefactors. To mark the occasion of this latest and most important honour, his colleagues, friends and students arranged for the publication of a book recording the research conducted by him in immunology, microbiology, pathology and the prophylaxis of infectious diseases of men and animals. This volume, entitled *Forty Years of Research and Achievement*, has now been published presenting in its eight hundred pages the vast amount of work conducted by him.

Through the kindness of Dr. Ramon, the Journal is permitted to publish excerpts from his book and one is presented in this issue. The chapter has been chosen which describes the methods which he used in his investigations.

In closing his memorable book, Ramon states "This is the final conclusion of forty years of research which has had no other object than the safeguarding of man from certain diseases which directly menace him and from scourges which, raging among domestic animals, are prejudicial to his welfare." Ramon quotes Pasteur's remarks to his pupils massed on the benches of the great amphitheatre of the Sorbonne: "Live in the serene peace of laboratories and libraries. Say to yourself first: 'What have I done to improve my knowledge?' Then, as

you make progress, say: 'What have I done for my country?' . . . it is necessary when one gets near to the great goal to have the right to say to oneself: 'I have done what I could.' And, repeating Pasteur's words, "I have done what I could", he closes this presentation of his work.

The world should know how much Dr. Gaston Ramon has contributed to the welfare of mankind. Canada, in particular, has reason to express again its lasting indebtedness to this great scientist and world benefactor.

NATIONAL VOLUNTARY PUBLIC HEALTH AGENCIES

Publication by the Health League of Canada of a booklet of eighty pages entitled *National Voluntary Health Associations in Canada* draws attention to the very important contribution which is being made by these agencies in the advancement of public health. At the last annual meeting of the Health League of Canada, sixteen of the national voluntary health associations accepted an invitation to outline their work. Each of these agencies has as its objective the control of some particular disease entity. On this occasion each association outlined its program and the problem being attacked. The Health League, in arranging this conference, felt that it was timely to provide the opportunity of a public explanation of what is being attempted by these representative agencies.

Attention of public health leaders was drawn to this subject by Dr. G. J. Wherrett on the occasion of the Canadian Public Health Association's annual meeting in Saint John in 1956 (1). Dr. Wherrett expressed concern at the number of agencies presently in the field, the multiplicity of financial appeals and the possibility that additional organizations might be established as new needs are recognized. Subsequently, Dr. Stewart Murray was appointed by the Canadian Public Health Association as chairman of a committee to confer with Dr. Wherrett and to report to the Executive Council.

The Health League has made a helpful contribution in publishing the outlines of the special interests of these sixteen agencies. This will contribute to a better understanding of the problems of our national voluntary health-promoting agencies. Their work is highly important, but for the maximum service attention must be focused on prevention rather than on treatment. In general, there appears to be little overlapping of efforts in the work of these associations, but all have a common problem of financing. It is wise that thought be given to the present situation and to the development of some plan which might permit of action by these agencies to prevent duplication of effort and to co-ordinate the raising of funds.

REFERENCE

1. Wherrett, G. J.: *Canad. J. Pub. Health*, 1956, 47: 457.

NEWS NOTES

Federal

Dr. P. E. Moore, director, Indian and Northern Health Services, Department of National Health and Welfare, attended the twenty-first meeting of the WHO executive board which began its sessions in Geneva, Switzerland, on January 7. He was accompanied by Dr. B. D. B. Layton, principal medical officer, international health, as alternate delegate.

A national health grant of \$444,300 was recently approved to assist Alberta in its plans to raise the standards of laboratory and X-ray equipment in 67 hospitals in all parts of that province. Officials of the provincial Department of Public Health have been carrying out a careful study of the needs of individual hospitals for some time. Along with substantial quantities of new equipment to be purchased, there will be exchanges of present X-ray apparatus among a number of hospitals to ensure the most effective distribution of diagnostic equipment.

The Canadian Federation of Biological Societies was formed in Ottawa on October 11, 1957, and comprises four member societies: the Canadian Physiological Society, the Pharmacological Society of Canada, the Canadian Association of Anatomists, and the Canadian Biochemical Society.

A national health grant of more than \$26,000 was recently approved for the new Norfolk County Health Unit in Ontario to help meet the cost of its services in the current fiscal year. This unit began to operate September 1, 1957, and serves about 45,000 people. It is directed by Dr. J. R. Mayers, formerly on the staff of the New Brunswick Department of Health and Social Services.

Dr. H. R. McLaren, dental health division, Department of National Health and Welfare, has been granted specialist certification in dental public health by the Royal College of Dental Surgeons of Ontario.

Hospital construction grants recently approved under the National Health Program include: *Nova Scotia*—Highland View Hospital, nurses' residence, Amherst, \$9,066; *Quebec*—Montreal Protestant Hospital, \$222,905; Hôpital Laval, Ste. Foy, \$196,106; Montreal General Hospital, \$22,000; St. Mary's Hospital, Montreal, \$43,500; *Ontario*—Salvation Army Grace Hospital, Toronto, \$124,773; St. Vincent de Paul Hospital, Brockville, \$65,510; Stratford General Hos-

pital, \$5,685; *Saskatchewan*—Leoville Union Hospital, \$13,000; *British Columbia*—Chilliwack General Hospital and nurses' residence, \$141,830; Kootenay Lake General Hospital, Nelson, \$136,040; Grand Forks Gyro Community Health Center, \$6,420; St. John Hospital, nurses' residence, Vanderhoof, \$7,000.

Mrs. Ragini Anet, Ph.D., formerly with the National Research Council, Ottawa, and Miss Irena Maria Mazurkiewicz, Ph.D., formerly a research assistant with McGill University, Montreal, have joined the Food and Drug Directorate, Department of National Health and Welfare, as chemists. Dr. Anet is working in the pharmaceutical chemistry section and Dr. Mazurkiewicz in the pharmacology and toxicology section.

Manitoba

Dr. Morley S. Loughheed, former medical health officer in Winnipeg, was elected a vice-president of the American Public Health Association at its annual meeting in Cleveland.

The annual meeting and fiftieth anniversary of the Manitoba Medical Association will be celebrated October 6–10, 1958.

Dr. C. R. Donovan, who served the Department as Acting Deputy Minister of Health before his retirement in 1955, has been assisting in the Bureau of Hospitalization during the extended illness of its director, Dr. E. Rafuse. Dr. Rafuse returned to the Department on January 6.

Tribute was paid to the late Anna E. Wells by the Manitoba Department of Health employees, when the Hon. R. W. Bend placed a picture in the library honoring this pioneer in the field of Public Health. Miss Wells was active in public health nursing and education in Manitoba for 36 years, up to the time of her death in August, 1953. It was fitting that the picture of Miss Wells should adorn the library which she was instrumental in establishing.

Plans for the fluoridation of the water supply at Dauphin and Portage la Prairie have been approved by the Provincial Government. This raises to five the number of such municipal installations in Manitoba, covering 40% of the population of the province, probably one of the highest indices in Canada.

On completion of the Manitoba Government's 1958 program, all Manitoba school children will have received free polio vac-

cine. This includes children from the age of six months to the end of high school. Since 1955 approximately 220,000 Manitobans have been vaccinated.

As of January 1, new regulations concerning bedding and upholstered furniture became effective in Manitoba. They are modelled closely on those already existing in the province of Ontario, and include the requirement that one of four labels be attached to all articles coming under the regulations. The regulations are being administered by the Environmental Sanitation Section with Mr. W. G. Davies as Inspector of this particular project.

Thirty-four hospitals have used the Consultant Dietitian Service recently established by the Provincial Health Department. This service is available to all hospitals and small institutions that have not the services of a trained dietitian.

Ontario

Dr. Claude Bissell has been appointed President of the University of Toronto from July 1, 1958. Now President of Carleton University in Ottawa, Dr. Bissell was Vice-President of Toronto University from 1952 to 1956 and for the previous four years had been Assistant to President Sidney Smith. He was also Associate Professor of English and Dean of Men in University College. Dr. Bissell is a graduate in Honour English and History of University College and of Cornell University, where he obtained his Ph.D. degree.

Dr. L. A. Pequegnat, Past President of the Association is retiring as Medical Officer of Health for the city of Toronto. Dr. A. R. J. Boyd has been appointed acting Medical Officer of Health.

Dr. W. E. McBean, formerly of England and Newfoundland, assumed office as director of the Ontario County Health Unit in August, 1957.

Dr. L. H. Douglas, previously with the Halton County Health Unit, has become director of the Port Arthur and District Health Unit which was organized a year ago.

Dr. M. R. Warren is director of the Fort William and District Health Unit.

Dr. Joan Langford is assistant director of the Stormont, Dundas and Glengarry Health Unit with headquarters at Cornwall.

Dr. C. A. Harris has retired as medical officer of health for London and Dr. H. J. Lambert has been appointed to this position.

Dr. John F. Paterson, chief of the chest clinic, Toronto Western Hospital, has been appointed to study the incidence and related factors of silicosis among miners in Ontario. A long-term control program has been carried on for a number of years by the department and the industry as a co-operative effort.

The nursing division of the Ontario Department of Health is introducing a new evening course for certified nursing assistants. The classes will be given on two evenings a week and for a full day on Saturdays. Towards the latter part of the course there will be a concentrated period of four months' supervised hospital experience. The course is open to persons over 17 years of age with a grade eight education or its equivalent. Since the nursing assistant program was inaugurated in 1946, 2,800 assistants have been certified. They have now become a recognized part of the nursing team working under the supervision of professional nurses and doctors in hospitals, institutions and private homes.

Quebec

Dr. Charles A. Roberts, formerly of the Department of National Health and Welfare, Ottawa, has been appointed medical superintendent of Verdun Protestant Hospital. He is the fourth superintendent since the hospital was founded in 1881, and succeeds Dr. George E. Reed, who retired last spring. Dr. Roberts is a Newfoundlander and received his medical training at Dalhousie University. He served in the R.C.A.M.C. from 1942 to 1945. He was named chief of the Mental Health Division, Ottawa, in July, 1951, and four years later was made principal medical officer.

New Brunswick

The Hon. Dr. J. F. McInerney, Minister of Health and Social Services, has announced the establishment of an Interim Study Committee which is to undertake a study of facts and figures on a Hospital Insurance Plan for the Province of New Brunswick. The Committee is to submit a report of the study upon its completion to the Minister of Health and Social Services. The Committee is composed of seven members under the chairmanship of Mr. B. Guss, Q.C., Saint John. The members are as follows: Dr. C. R. Trask, Director, Saint John General Hospital; Rev. Mother St. George, Provincial Bursar, Religious Hospitalers of St. Joseph; Mr. D. O. Downing, Associate Director, Maritime Hospital Services Association; Mr. William McNichol, Assistant Comptroller General, Department of Provincial Secretary-Treasurer; Dr. C. W. Kelly, Director of Health Planning Services, Department of Health and Social Services, and Mr. R. Bennett, retired, from Moncton. Since the original proposals for a Hospital Insurance Plan from Ottawa in 1956, the New Brunswick Department of Health and Social Services has engaged in considerable investigation and research of a preliminary basic nature.

Dr. Lachlan MacPherson has been appointed superintendent of the Saint John

Tuberculosis Hospital to succeed Dr. R. J. Collins, who retired from that position on October 1. Dr. Collins had been superintendent of the hospital since 1930, during which period the hospital has been expanded and the treatment of tuberculosis has changed remarkably. On retirement, Dr. Collins was honoured at a reception by the commissioners, staff and medical consultants of the hospital.

Dr. H. L. Logan has retired from the position of District Medical Health Officer for the counties of Kings, Queens and Sunbury. He had served in Sussex since 1934 except for a period during World War II when he served overseas.

Prince Edward Island

Dr. M. L. Bonnell, Provincial Minister of Health, has announced that Salk polio vaccine will be made available without charge for the adult age-group between 19-40 years by the Prince Edward Island and federal departments of health. The vaccine will be distributed to physicians and the P.E.I. Polio Foundation. The latter will arrange for the establishment of special clinics and there will be no charge to the patients in the special clinics. Up to the present time vaccine has been made available to all children and teenagers up to 19 years under the direction of the Division of Public Health Nursing and there has been 90% coverage of at least two doses for young people in the 1-19 age-group.

An extension of the services of the Orthopedic Center in Charlottetown was announced by Dr. M. L. Bonnell. The Orthopedic Center, which cares for tuberculous bone and polio cases, will now extend services to include treatment for congenital malformations, cerebral palsy, accident cases and other forms of disease. The program, for the present, will be limited to children of 16 years and under who are chronically disabled by any of the above diseases. A medical assessment board has been established to appraise the eligibility of a person to receive treatment at the Center. Persons needing treatment must be referred either through their family

physicians or through the Department of Health and Welfare.

The Provincial Department of Welfare recently moved its offices to the Provincial Building. Heretofore it had been located in the same building as the Department of Health. The Division of Laboratories will occupy most of the vacated space.

Mr. Ian Campbell, National Co-ordinator of Civilian Rehabilitation with the National Department of Labour, and Dr. Bertrand Primeau, Medical Consultant of the Medical Rehabilitation and Disability Advisory Service of the Department of National Health and Welfare, early in January held a series of meetings with provincial groups interested in the rehabilitation of disabled persons. Mr. Campbell and Dr. Primeau came to Prince Edward Island at the request of the Medical Society in order to evaluate rehabilitation needs and to advise on a comprehensive long-range program in this field. During their visit they held discussions with the Executive of the Medical Society, officials of the Department of Health, the Provincial Co-ordinator of Rehabilitation, officers of the Rotary Club and the Red Cross Society. They also surveyed the present facilities at the Rehabilitation Center. During their stay they addressed a meeting of the Prince Edward Island Medical Society on the subject: "Planning Rehabilitation Services".

Robert Forsythe, M.D., C.M., has recently received his Certification in Psychiatry from the Royal College of Physicians and Surgeons (Canada). All five psychiatrists working in the Division of Mental Health are now certified. Dr. Forsythe is a native of Charlottetown and received his university education at Prince of Wales College, Charlottetown, and Dalhousie University.

Dr. W. J. P. MacMillan died on December 7, scarcely a week before he was to take office as Lieutenant-Governor of the province. Dr. MacMillan was the first minister of education for Prince Edward Island and also the first minister of public health. He was greatly honoured as a physician, scholar and statesman and Canada has suffered a great loss in his passing.

Coming Meetings

Canadian Public Health Association, May 19-23, Hotel Vancouver, Vancouver, B.C.
College of General Practice, April 14-16, Royal Alexandra Hotel, Winnipeg, Man.
Canadian Conference on Social Work, June 1-6, Montreal, Que.
Canadian Medical Association, June 15-19, Halifax, N.S.

Canadian Tuberculosis Association, Chateau Frontenac, Quebec City, June 9-12.
Ontario Medical Association, Royal York Hotel, Toronto, May 12-16.
Ontario Public Health Association, Toronto, September 29-October 1, 1958.

Books and Reports

THE PATIENT AND THE MENTAL HOSPITAL by Milton Greenblatt, M.D., Daniel J. Levinson, Ph.D., Richard H. Williams, Ph.D. The Free Press, Glencoe, Illinois. 658 pp., \$6.00

This volume represents papers and discussion of a recent research conference on Socio-Environmental Aspects of Patient Care in Mental Hospitals. Sixty investigators from the United States, England and Canada were invited to participate in this conference and the present volume represents in condensed form all the papers and the collective efforts of the participants. Four topical areas of socio-environmental influence upon the hospitalized mentally ill were distinguished: (a) the hospital organization as a whole, (b) the therapeutic personnel, (c) the ward, (d) the extra-hospital world. These were the major divisions of the conference's consideration. A "work group" of ten to fifteen members was established for each topical area. An introductory chapter based on the work group discussions and plenary discussion reports has been presented first in each of the four sections. In the fifth and concluding section the editors attempt to gain a wider perspective on the conference and on mental hospitals generally. In all, sixty contributors share in the presentation in some 38 chapters. The vast amount of work entailed in presenting this important series of papers and discussions in one readable and effective volume is appreciated and evidence on every hand indicates the care with which the work has been done.

The editors were Dr. Milton Greenblatt, assistant superintendent and research director at Massachusetts Mental Health Center and assistant clinical professor of psychiatry at Harvard Medical School; Dr. Daniel J. Levinson, research associate in social science and psychiatry at Harvard Medical School, and Dr. Richard H. Williams, social science consultant at the National Institute of Mental Health.

ASPECTS OF RIVER POLLUTION by Louis Klein, M.Sc., Ph.D.(Lond.), F.R.I.C., M.Inst.S.P. Butterworths Scientific Publications, 1957, 621 pp., \$14.50.

This comprehensive work is an important contribution to the knowledge of river pollution. Dr. Klein is Chief Chemist, Mersey

River Board, England, an organization serving a district where an unusually wide range of aspects of pollution may be studied. For 12 years he was research chemist in the Manchester Corporation's Rivers Department. He has had first-hand acquaintance with the problems of various polluting discharges and the methods which can be used for purifying. Dr. Klein has rendered a most valuable service in surveying critically the extensive literature on the subject. He has included references to more than 1,300 original papers. The book is divided into 15 chapters, each of which covers a particular aspect of river pollution. Dr. J. R. Erichsen Jones, lecturer in zoology, University College of Wales, has contributed a chapter on "Fish and river pollution" and Mr. H. A. Hawkes, M.Sc., has contributed a chapter on "Biological aspects of river pollution". Other chapters include Legal aspects of river pollution, Nature and Effects of pollution, Causes of river pollution, Uses of river water, Biochemical and physico-chemical aspects of river pollution, Detection and measurement, Significance and Interpretation of chemical tests, Physical characteristics of rivers, Abatement of pollution, Standards for rivers, Present and future status of river pollution.

This volume will be of great value to those directly concerned with anti-pollution work and although the book is written primarily from the standpoint of British practice, the subject matter has application to conditions in other countries. The author is to be congratulated on this fine work. As the subject of river pollution is receiving urgent attention in Canada, all who are concerned will appreciate Dr. Klein's authoritative volume.

A CLASSIFIED BIBLIOGRAPHY OF GERONTOLOGY AND GERIATRICS, Supplement One 1949-1955, Dr. Nathan W. Shock, Chief, Gerontology Branch, National Heart Institute, National Institutes of Health and the Baltimore City Hospitals. Stanford University Press, Stanford, California, 525 pp., \$15.00.

In 1951, Dr. Nathan W. Shock prepared his original bibliography of gerontology and geriatrics in which he covered almost the half-century from 1900 to 1948. He has now published the first supplement covering the period 1949-1955. This supplement lists

18,036 references indicating the large number of papers which are being presented in these fields. In fact, the references in the supplement are almost as numerous as in the original bibliography and relate only to a period of six years. The bibliography is now a standard work and the present supplement fills the urgent need for a convenient guide to the most recent references in the field. Dr. Shock has included material not readily accessible and has listed papers that have appeared in Russian and other slavish languages. It is a volume that will be found in every medical research library.

Publication of both volumes has been made possible through the support of the Forest Park Foundation, Peoria, Illinois. The bibliography, therefore, represents the work of Dr. Shock and the Gerontology Branch of the National Heart Institute, National Institute of Health and the Forest Park Foundation.

Craig and Faust's CLINICAL PARASITOLOGY, by E. C. Faust and Paul F. Russell. Lea and Febiger, Philadelphia, 1957, 1078 pages, \$15.00.

Students of medical parasitology will welcome the sixth edition of *Clinical Parasitology* by two of America's leading authorities in parasitology and tropical medicine. Dr. Faust has had a long and distinguished career in research and teaching of medical parasitology. Dr. Russell is equally well known for his contributions to our knowledge of tropical diseases and for his part in control of these diseases, resulting in the improvement of public health in many parts of the world.

This valuable text book, intended for students of parasitology, clinicians and public health workers, has been revised extensively and several parts have been rewritten in order to present the new knowledge relating to the diagnosis, treatment and control of parasites of man and the signi-

fiance of this knowledge in public health practice.

The book is divided into five sections as follows:—

I *Introduction and general consideration of parasitology*. This section includes chapters on the parasite and its environment, epidemiology, nomenclature, disease processes due to animal parasites, diagnosis, treatment, prevention and control, and historical landmarks in parasitology. II *Protozoa and protozoan infections*. The morphology, physiology, life history and classification of the protozoa are considered in the first chapter. This is followed by chapters on the various types of protozoa that infect man. III *Helminths and Helminthic Infections*. The nematodes, tape-worms, flukes, thorny-headed worms and leeches all come in for consideration. IV *Arthropods and Human Disease*. Arthropods that are themselves parasitic or which act as vectors of parasites, or which cause disease because of their "bites" or toxin injected into man, are considered. The section concludes with an important chapter on the Control of Arthropods of Medical Importance. V *Technical Appendix*. This useful appendix gives techniques for examining and culturing parasites, diagnosing infections and studying immunological phenomena.

The lists of important references that follow each chapter will be especially useful to those who wish to read more extensively. Students will appreciate seeing also the derivation of many of the names of parasites—a valuable feature of previous editions of this book. This classical touch is somewhat offset, however, by the tendency to anglicize the plural endings of such words as ameba, larva, papilla, etc. This text is likely to be used extensively in schools and colleges which provide courses in medical parasitology and tropical medicine. It will be welcomed also by physicians, students of public health and those in public health laboratories.

SOCIETY OF MEDICAL OFFICERS OF HEALTH—ENGLAND 1959

A communication has been received from Sir Selwyn Selwyn-Clarke, Secretary of the Society of Medical Officers of Health, Tavistock House South, London, England. This is the oldest society of medical officers of health in existence, having celebrated its centennial in 1956.

The Society would like to arrange plans for a reception of Canadian colleagues who will be in the United Kingdom in July 1959

for the joint meeting of the Canadian and British Medical Associations.

The national office of the Canadian Public Health Association, in an effort to assist the Society, requests that any medical or dental officer planning to attend the Edinburgh meeting of the C.M.A.—B.M.A. contact our office in order that we may forward information to the Society of Medical Officers of Health.

